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Concreting at Pine Canyon Dam

Equipment, handling and control represent modern mass-concrete practice—Vibrators place "no-slump" mix deposited by 4-yd. buckets—Low-heat cement cuts maximum concrete temperature about 20 deg.

CONCRETING methods typifying modern developments in dam construction from the handling of material to the placing of a dry mix with the aid of vibrators are in use on the Pine Canyon Dam being built by the Pasadena, Calif., water department on the San Gabriel River. Important features include: (1) extent of mechanized operations, (2) special low-heat cement and rigid concrete control, (3) cableway and bucket placement, and (4) "no-slump" mix and vibrated placing. The dam is of gravity design containing 440,000 cu.yd. of concrete, 240 ft. high above streambed elevation and is scheduled to be completed by the end of the year.

Pine Canyon Dam is being built to provide 40,000 acre-ft. of surface storage to augment the present municipal supply of Pasadena, which is obtained from wells. As the result of the continued subnormal precipitation in southern California during the past decade, coupled with the expanding use of the available water supplies, the average pumping lift in the municipal wells has increased from 209 to 308 ft., with corresponding increase in cost. The storage developed by Pine Canyon Dam is being provided to supplement this underground supply and to insure against possible deficiency.

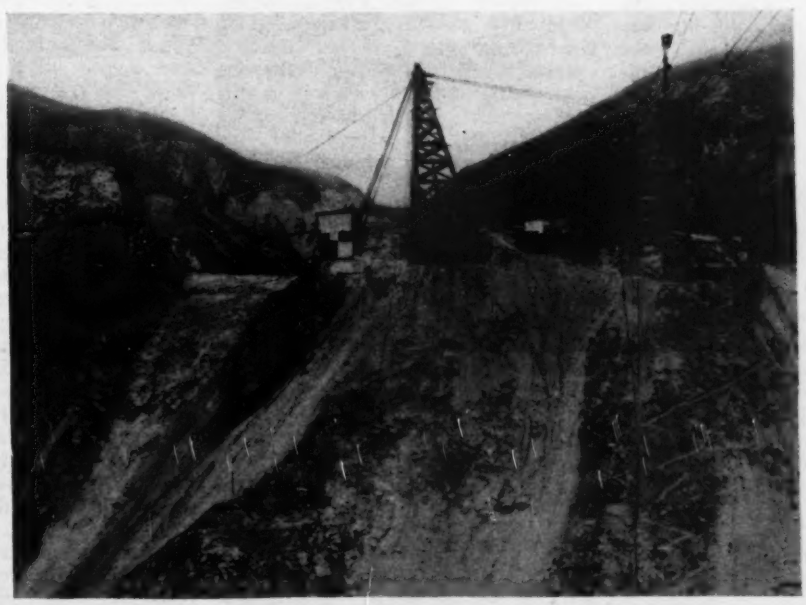


Fig. 1—Transfer point on the extensive aerial transportation system which delivers materials for Pine Canyon Dam. At this point aggregates and cement brought in on an aerial tramway system are fed to the mixing plant at the right, which discharges into buckets of cableway, the tail tower of which is shown at the left on the edge of the spillway cut.

Distribution of water

As a member city of the Metropolitan Water District of Southern California, Pasadena will ultimately be supplied by means of the Colorado River aqueduct, and the Pine Canyon reservoir will become one of the principal distribution reservoirs of that system.

The San Gabriel Mountains are recognized as an area subject to seismic disturbance and traversed by numerous faults, some of which may be alive. In addition to this general problem, the design of the dam was further complicated by a fault that traverses the canyon longitudinally at the site. A design for resisting an earth-

quake shock with an acceleration of 0.1 gravity was adopted, and provision was made for a definite movement along the local fault. The details of these provisions, including the special key system left through the dam over the fault, have not been completed and will require subsequent description.

For the purpose of describing concreting operations, however, the dam can be considered as a straight gravity section for a distance of 130 ft. in the streambed section, with two transition sections on either side and wings slightly curved with a radius of 716 ft. (Fig. 2). In maximum section (Fig. 3) the structure is 328 ft. high above lowest point in the foundation, with a uniform downstream batter of 0.81:1 and an upstream batter of 0.05:1. The crest length is 750 ft., and its width is 20 ft., with provisions for a roadway. Because of the open joint and a highway location that could not be abandoned during early stages of the work, the spacing of vertical construction joints is not uniform, although normally designed for 50 ft.

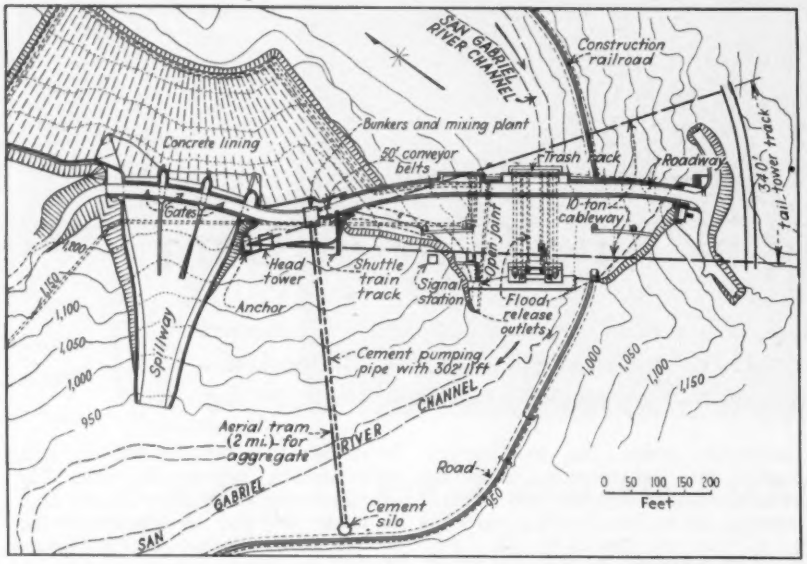


Fig. 2—Dam-site area, showing arrangement of construction plant and cableways to handle concrete.

Outlets

A complicated system of outlets is provided to take care of streamflow requirements in accordance with water rights of lower interests, in addition to the intake of the present municipal supply and the connection with the ultimate metropolitan district system. For the present the municipal supply from the reservoir will be conveyed by a 40-in., 18-mile pipe line connecting with the present Pasadena system. An 80,000-sec.ft.-capacity spillway is provided and will be equipped with three radial gates.

The paving of the area upstream from the spillway as well as the spillway discharge channel will require about 32,000 cu.yd. of concrete and is one of the major construction features of the project.

Construction plant

Aggregate, including sand and four gradings up to a 6-in. maximum size of cobble, is transported up the canyon to the site by means of a 2-mile aerial tramway of 225-ton-per-hour capacity, after a 2-mile railroad haul from a near-by commercial gravel pit. The tramway is supported on fifteen timber towers, including the terminals and one double-tension station that provides a 28-deg. horizontal angle in the line. Track cables are of the locked-coil type, 1 5/8 in. in diameter on the loaded line and 1 in. on the return. The tramway operates about 10 buckets of 1½-cu.yd. capacity, released and attached automatically at the terminal stations. A 150-hp. electric motor provides the driving power through a 1-in. hauling line. At the loading end a crew of three attends to loading, and one man operates the conveyor system that keeps the bunkers filled from the aggregate stockpiles. One man at the discharge end controls the proper filling of the bins over the mixer plant. The driving motor and operator are at the discharge terminal.

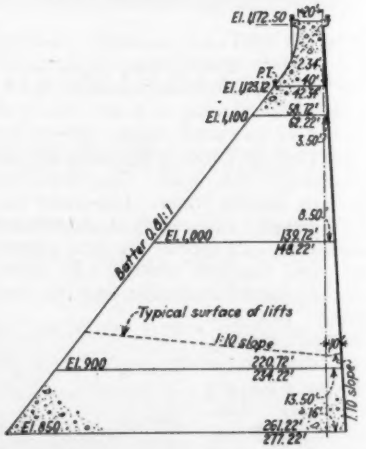
Discharge from the tramway is made into aggregate bins directly over the mixing plant, which is located on the west side of the site at the elevation of dam crest. From the aggregate bins the material is handled by two weighing batchers discharging into two 4-yd. mixers. Water is measured through individual automatic meters.

Bulk cement is hauled to the site in trucks and trailer units, handling a total load of about 21 tons. These units discharge the cement into a 4,000-bbl. silo at the road elevation several hundred feet downstream from the site and practically underneath the last span of the aerial tramway. From this storage the cement is pumped 730 ft. to the bin at the mixing plant up a vertical lift of 302 ft. (*ENR*, Feb. 23, 1933, p. 241.) Cement is weighed in a separate scale and is confined in a section of the hopper to eliminate contact with the moist aggregate before it is admitted to the mixer.

In common with other modern mixing plants, the entire operation is well motorized and carried on with a minimum amount of labor. One man controls each mixing operation, weighing the batch by a system of air controls, and the mix, after being admitted, is timed automatically for a 3-min. period.

Two 10-ton cableways span the canyon from a common head tower near the mixing plant to tail towers on a radial track on the opposite canyon wall. These cableways intersect the end of the tramway system at the mixing plant (Fig. 1) producing in reality a complete aerial transportation system for the aggregate and concrete, with the intermediate stop at the mixing plant where the cement and water are added.

Fig. 3—Maximum section, showing principal dimensions and slope required on surface of lifts.



The cableways have a span of 1,000 ft. and are provided with 2½-in. track cables. The timber-frame head tower is 100 ft. high, with the gravity concrete anchorage located immediately behind. The two counterweighted tail towers operate by remote control along a track 340 ft. long at a speed of about 150 ft. per minute.

Cableway operations are controlled by separate signal men directing the hoist men by electric signal and telephone. The signal men are located in a station built out from the west abutment. The cableway system is being used to place all the concrete in the structure (Fig. 4), with the exception of a small amount in the downstream toe that could not be reached and required rehandling with a stiff-leg derrick. The cableway system, using 6 cu.yd. skips,

was also used to complete streambed excavation.

Concrete placing

Each concrete mixer discharges onto a 50-ft. conveyor belt that delivers the mix through a hopper into a 4-yd. bottom-dump bucket brought into position under the end of the conveyor belt by an industrial locomotive and flat car operating on a short shuttle track. The operation of this shuttle train, which serves both cableways, is the connecting link between the mixing plant and the cableway distribution system.

One of the important links in the successful operation of this placing system was the transfer of buckets at this station. Considerable study was given to this operation because of the extent of the personal element required in lowering the empty bucket onto the car and the changing of the hook to the loaded bucket. Initial operations of this system gave indications that this personal factor might prove a handicap; but later developments showed that the difficulty was caused by inexperience, and subsequent operations have proved that the personnel, after sufficient training, are able to effect this change with practically no delay.

The efficient handling of this interchange is more unusual because it requires the coordinated effort of four men, including the "blind" operations of the hoist men. Directions for returning the empty bucket to the shuttle car are given by the signal men to the hoist operator. As the bucket is lowered to the car and comes to rest the signal is given to lower the block slightly to permit unhooking from the empty buckets. The slight sag of the hook and the sudden stop are sufficient to produce a slight rebound in the cableway; during this short interval the locomotive driver moves the train to put the loaded bucket directly under the hook, so that with a second slight lowering of the hook the bucket man hooks the loaded bucket and the operation is complete. The precision and speed with which this four-man crew performs this operation is one of the features of the work. An ordinary interchange is accomplished within 10 sec.

Concrete is placed in 5-ft. lifts on the individual blocks, with specifications requiring a 64-hour period before the next concrete can be placed. Formwork has no particularly unusual features; the metal-lined timber panels are built up on the job, moved by cableway and used in successive lifts with the usual system of braces and tie wires. No horizontal keyways are left in the surface of the lifts. Specifications require that the level of the concrete be carried up at an angle of 1:10 sloping up from the upstream face of the dam. In the lower lifts, with a 250-ft. up- and downstream length of block, this required that the panel forms be maintained at a corresponding slope, so that

Fig. 4—Dam site, looking upstream, with traveling tail-tower track at upper right and signal station at left. Roadway through the dam, which has delayed work on the right abutment, will be abandoned soon, with completion of a new high-level road.

the downstream forms were approximately five lifts higher than the upstream panels. After the operations of this system had been established there was no particular difficulty in handling the forms.

Under normal operations each bucket is used to place concrete on an individual block, and the 4-yd. loads are handled by a crew of eight men, including foreman. The bucket is maneuvered to within about 3 ft. of the surface and is tripped by the concrete crew. In the original bucket design it was necessary for the doors to be reclosed by members of the crew, but subsequent improvements have added counterweighted handles and other details to make the doors self-closing. The concrete batches are worked by means of three electric internal-type vibrators and one external platform-type electric vibrator operated

Fig. 5—Shuttle train loading 4-yd. batches of concrete at end of 50-ft. conveyor belts from mixers. The train moves the buckets under the cableway for transfer.

by two men. Little shoveling is required, and the vibrating is sufficient to flatten out the concrete and bury the large-size cobbles. It is the opinion of those in charge of concreting operations that the vibrators make it possible to compact thoroughly a much drier concrete than could be handled by any other method.

The cableway system of placement is working very satisfactorily, with the usual difficulties being experienced in handling the buckets near the forms and in places where outlet pipes or the drainage system provide complications.

As soon as the concrete has obtained its initial set, the surface of the pour is given a wire brushing to remove the laitance and roughen the surface. The dry mix of the concrete results in producing little surface accumulation, and less than 1/8 in. is brushed off. Before the next lift of concrete is placed the surface is given two flushings with air and water, one just before concreting starts.

Concrete control

The outstanding feature of the concrete technology is the use of special low-heat cement prepared by four local cement mills according to special specifications outlined in *ENR*, Oct. 6, 1932, p. 410. The testing of chemical properties by the aid of the heat-of-solution process is carried on in the city laboratory. Physical properties of the cement and all tests of the aggregate and concrete are made in a well-equipped field laboratory. Tests to date show that the cement has a 65-calorie-per-gram heat of hydration at 28 days, as compared to the specification requirement of 80 grams for the same period and 65 calories at seven days. In other words, the cement does not exceed the seven-day heat requirement at the end of 28 days, and at the same time it meets other specifications.

The resulting concrete, according to the longest record now available, shows a total heat rise of 36 deg. (72-deg. pouring temperature) to a maximum of 108 deg. at the end of four months with the curve horizontal. Calculations indicate that this maximum temperature of 108 deg. corresponds to a probably high figure of 130 deg. if ordinary cement had been used. The resulting difference of about 20 deg. represents the saving in stress from heating and cooling effected by the new cement.

Actual control of the concrete on the job begins with the testing for moisture content in the sand and smallest grade of aggregate, which is done at the mixing plant at about 20-min. intervals. Samples of the concrete are taken twice during each shift. These complete samples taken directly at the mixer are removed to the field laboratory and used to make one 14x28-in. specimen containing all of the aggregate and two standard 6x12-in. specimens containing aggregate under the 1½-in. size. These specimens

Fig. 6—Starting to dump a 4-yd. bucket of concrete. The bucket is designed to be self-closing, but if it fails to shut the man with the hook completes closure.

are stored under standard conditions and broken in a 600,000-lb. machine at the field laboratory at the usual intervals of 7 and 28 days and at longer periods.

The concrete mix and proportioning is based on producing a 2,000-lb. concrete for the bulk of the dam. Tests indicate that the concrete obtained is averaging this requirement satisfactorily with correspondingly good qualities for other requirements. Cement content averages 0.95 bbl. per cu.yd. of concrete with the exception of that placed in the upstream 10-ft. thickness, which is enriched by increasing the cement content to 1.1 bbl. per cu.yd. The proportioning and characteristics of a typical batch are shown in the accompanying table.

In addition to the progressive control maintained on the concrete material and results, an extensive research program is in progress. A series of seven uplift cells has been installed along the concrete-bedrock contact in the channel section, and other cells were installed within the body of the concrete and along pour joints higher up

Fig. 7—Handling a 4-yd. bucket load with vibrators. Note that the men do not sink into the surface of the concrete. In addition to the three internal vibrators shown, a platform type is used.

in the same block. In another block a series of 35 Carlson strain gages has been installed to indicate internal conditions in the block as well as temperature effects that can be measured by the same instrument. One group of these gages was placed about 50 ft. above bedrock, and another group about 50 ft. higher up in the section.

Resistance thermometers are being installed in the maximum (channel) section to secure a complete picture of thermal changes in this block. One of the thermometers was set 10 ft. into bedrock at the base. This instrument registered an original temperature of 65 deg., with a gradual rise following the placing of concrete to meet the concrete temperature at the end of five months and has continued to equal the concrete temperature, which is 77 deg. at the present time.

A series of strain plugs has been installed on the face of the open joint over the fault, where it will be possible to carry on an extended series of external measurements. Also, crack detectors consisting of 5-ft. glass tubes with silvered inside coating have been set at a few points where the possibility of cracks appears to be the greatest. This instrument is designed to indicate the occurrence of a crack when the breaking of the tube destroys an electric contact in the silver lining. As yet the time elapsed since the introduction of these recording instruments has not been sufficient to indicate any results, with the exception of the heat rise as noted.

CHARACTERISTICS OF TYPICAL 4-CU.YD. BATCH OF CONCRETE

	Lb.
Cement	1,429
Sand	3,912
Aggregate, ¼-¾ in.	3,042
Aggregate, ¾-1½ in.	1,449
Aggregate, 1½-3 in.	2,465
Aggregate, 3-6 in.	3,625

Cement = 0.95 bbl. per cu.yd.
Water (including sand moisture) = 851 lb.
Water + 2% wt. of sand for absorption = 929 lb.
Slump = 1 in.
c/w by weight = 1.68.
Design strength = 2,000 lb.

Note—In special mix for upstream 10 ft. cement is increased to 1,693 lb. (1.1 bbl. per yd.), providing a c/w of 1.35 and a design strength of 2,500 lb.

Organization

The Pine Canyon Dam project is being carried out under the general direction of S. B. Morris, chief engineer and general manager of the Pasadena water department. C. E. Pearce is designing engineer. Ross White is construction engineer for the project, and Verne L. Peugh is resident engineer at the dam.

Contract was awarded (April, 1932) to the joint contracting organization Bent Brothers, Inc., Winston Bros. Co., Wm. C. Crowell, on a low bid of $2,407,311. The manager of this joint organization on the project is Stanley Bent. Lee Brider is general superintendent, and Ed. Whipple is assistant superintendent.

Modern Factory Design in England

Concrete-frame building with glass walls, covering a site of 6 acres, is designed for special needs of a large firm of manufacturing druggists—Layout contemplates line production on ground floor, with storage facilities in upper stories

By E. Owen Williams
Consulting Engineer, London, England

THE NEW FACTORY of the Boots Pure Drug Co., Ltd., is a recent example of modern English industrial-building design. Three stories high, with reinforced-concrete frame and glass walls, the building, located at Beeston, Nottinghamshire, covers a ground plan of 6 acres and constitutes only a part of the plant ultimately to be built on the 200-acre site. The building incorporates an interesting arrangement of manufacturing facilities and some structural features of note, including mushroom-type floors, some concrete cantilever roof beams, glass-and-concrete roofs, and glass walls and partitions. As shown in Fig. 1, the building is designed so that all production is at ground-floor level, from the entry of the raw materials at the two sides to the shipping bay located on the center line. (Only half of this structure is now complete, so that the shipping bay at present is along one side of the building.) The packing materials and finished stocks are stored in multi-story sections flanking each side of the main hall in which the packing is carried out. Packing materials are fed to the packing benches by chutes, and the finished stocks are lifted to the upper floors by elevators on the opposite side of the hall. The multi-story sections are connected transversely by bridges at about 150-ft. centers extending the full width of the building and narrowing down to a width of about 15 ft. across the main hall.

The Boots Pure Drug Co., Ltd., owns nearly 1,000 chemist shops in Great Britain and also manufactures a large proportion of the chemicals and toilet articles that it sells. Its old factories in the city of Nottingham were developed with the growth of the business, and to that extent did not have the advantages either in site or arrangement of a factory planned as an entity for large-scale production. To achieve the efficiencies and economies of a factory specifically designed for the company's needs, it was decided to transfer manufacturing activities to the outskirts of the city. Here a site of more than 200 acres was acquired, which for the greater part provides good gravel foundations with satisfactory railway and road facilities and ample water supply.

The portion of the factory so far completed provides a floor area of 740,000 sq. ft., or about 27 acres; it incloses a volume of slightly more than 14,000,000 cu. ft. and was built at a cost of a little more than 9 shillings per sq. ft. of floor area. The ultimate building as now planned, with extensions to the east and north, will have a frontage of 700 ft. and a length of 1,000 ft. and will provide 50 acres of floor area.

The frame of the building is of reinforced concrete, the floors being designed on the mushroom principle. The main hall is spanned by steel trusses carrying a glass-concrete roof. This type of roof is also used in other parts

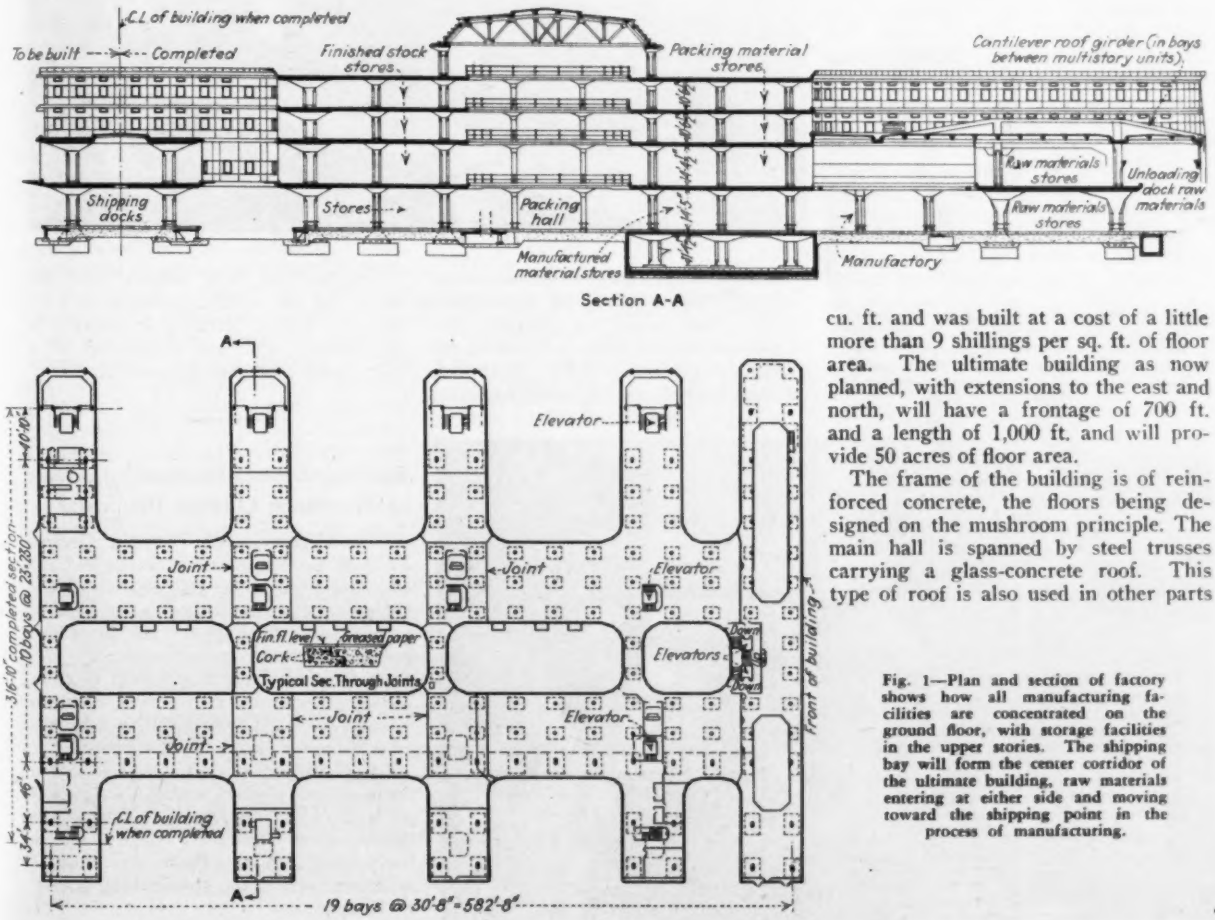


Fig. 1—Plan and section of factory shows how all manufacturing facilities are concentrated on the ground floor, with storage facilities in the upper stories. The shipping bay will form the center corridor of the ultimate building, raw materials entering at either side and moving toward the shipping point in the process of manufacturing.

Fig. 2—Front of English factory, showing reinforced-concrete frame and glass walls. The unit now built covers a 6-acre site. The ultimate center line of the front elevation is at the far corner of the building.
(Photo from *"Building,"* London.)

of the building where overhead lighting is necessary. It consists of circular glass units about 8 in. in diameter and 1¾ in. thick, centered at 9¼ in. in both directions, with the intervening spaces containing the reinforcement filled with concrete. These roofs are provided with sliding joints to take care of expansion and contraction. Exterior walls and interior partitions are of glass in steel frames, the exterior walls having weatherproof joints.

The building is divided into units (the largest being 107 by 64 ft.) by expansion joints. Similar joints have been arranged at points of future extension so that this may be effected without disturbing operations in the present building.

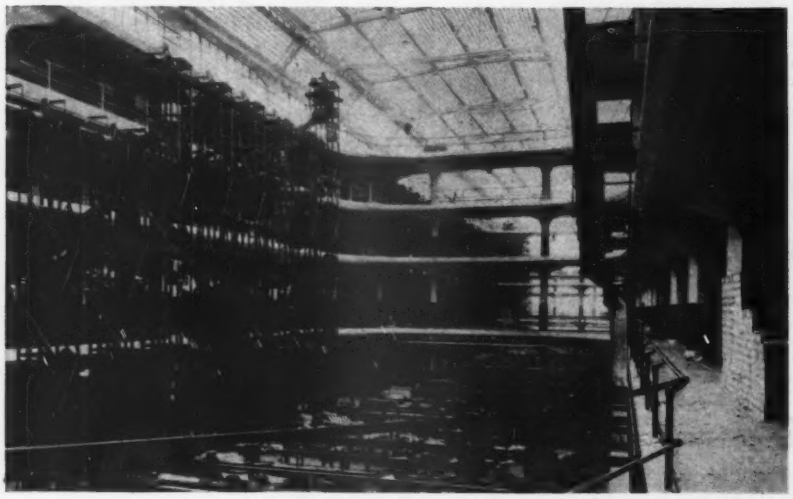
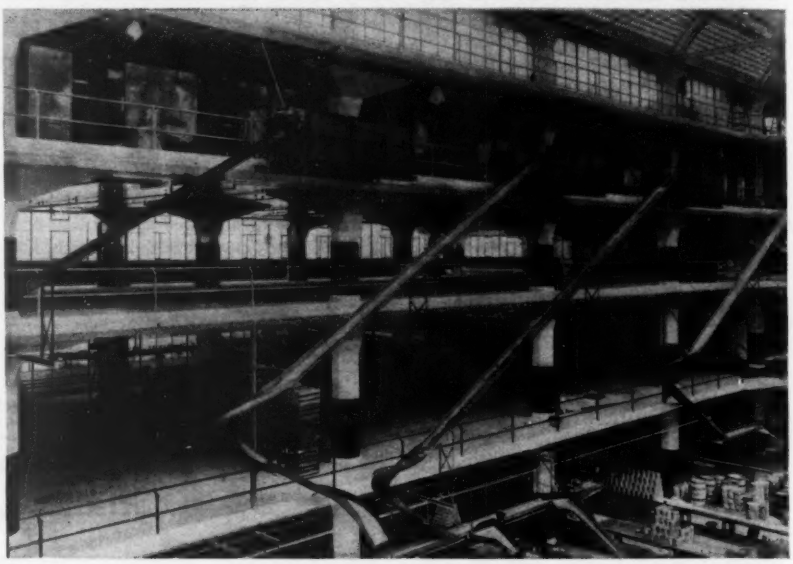


Fig. 3—Main hall, which houses the packing facilities. Materials are fed to the packing benches from storage through the chutes at the right. Elevators at left carry packaged products to finished-article storage. Note glass-concrete roof.
(Photo from *"Building,"* London.)

of hand-operated cradles suspended from a monorail at roof level.

In general, the floors were designed to carry 200 lb. per sq. ft. The concrete used in the superstructure consists of 3 parts coarse aggregate, 1½ parts sand and 1 part portland cement, and was designed to have an ultimate strength at 90 days of not less than 4,500 lb. per sq. in. To facilitate designing, planning and construction, a standard unit was adopted; and, with the exception of a few dimensions controlled by special conditions, all column spacing, floor heights, etc., are multiples of this unit.

Fig. 4—Glass walls and roofs furnish excellent daylight conditions. View shows main packing floor in center and raw-material storage space on upper floors.
(Photo from *"Architects Journal,"* London.)



Heating pipes run continuously along exterior walls about 2 ft. above floor level. These pipes are designed also to act as buffer rails to protect the glass. Arrangements have been made for cleaning the exterior walls by means

The building was planned and designed by the writer, working in conjunction with a planning committee of the owners, and was completed in a little more than twenty months.

Railway Into Gold-Mining Area of Northern Quebec Proposed

The Montreal and Western Quebec Railway Co. has been organized in Canada (reported to be a subsidiary of the Canadian Pacific Railway) to build a railway line to improve access to the gold-mining area of northwestern Quebec. The proposed line would start at Maniwaki on the C.P.R. line in Gatineau River valley and would run in a northerly direction until it has passed the Abitibi storage reservoir, thence in a northwesterly direction across the height of land of Grand Lac and then north again toward Senneterre where it enters the mining region. From this point it will turn west to the gold-mining region to Rouyn.

Inexpensive Water-Stage Recorder Developed

Los Angeles County Flood Control District develops instrument designed especially for intermittent use and featuring simplicity and low cost

FOR THE special purpose of recording fluctuations in water stage in the numerous streams and washes of Los Angeles County, which are dry except during heavy rains, the Los Angeles County Flood Control District has developed a simple water-stage recorder of low cost, with a novel arrangement for reversing the motion of the recording pencil. Many of the stations used by the district in its extensive hydrological work require only the temporary or intermittent use of a recorder, and these stations do not warrant the installation of the more expensive continuous type of instrument. Reliability and convenience have not been sacrificed in the design and construction of an inexpensive model.

The most novel feature of the instrument is the simple method of reversing the motion of the recording pencil: whenever the range of stage exceeds the length of the record drum the hydrograph peak shows in the opposite direction. The illustration shows the recorder and the principal features of the mechanism. The pencil-cord drum (A) carries a light braided waterproof silk cord that is attached to the pencil carriage (B) and fastened to a small lead weight to keep the cord taut and hold the pencil carriage in position. The drum end of the pencil cord wraps or unwraps as the float, actuated by the change in stage, moves the cable passing over the float sheave (C), which is geared to the pencil cord drum.

As the float rises, the pencil cord unwraps until the pencil reaches the far edge of the graduated paper. At this point the cord is entirely unwrapped but still connected to the pencil-cord drum. Continued rise of the float will cause the drum to rotate in the same direction as before, but the pencil cord begins to wrap up on the drum in the opposite direction, causing the pencil carriage to reverse. At the top of the pencil-cord drum are two small rollers that hold the cord in position as it winds or unwinds. Lost motion at the point of reversal is slight.

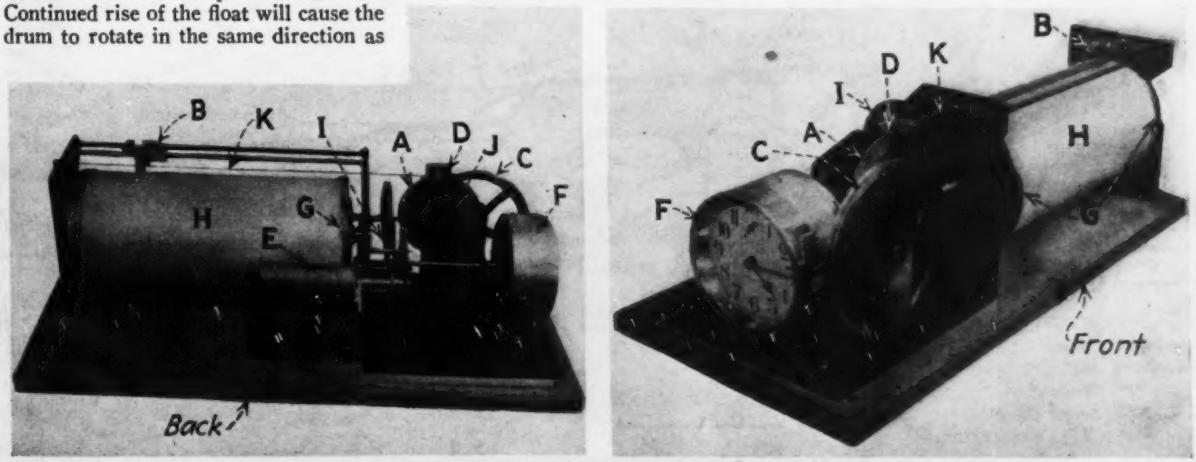
The recorder is designed for a horizontal-record paper drum (4.52 in. in diameter by 11⅛ in. long), which is revolved by a power weight of 15 lb. geared to the drum and regulated for speed by the escapement movement of an inexpensive alarm clock with the main spring removed. The paper is graduated in inches and tenths for a width of 10 in. for gage height (1-ft. rise of water stage equals a 2-in. movement of the pencil), and in tenths of inches around the drum for time interval. Two sets of time gears are provided: 0.1 in. in two hours, which represents twelve days per drum revolution or 0.1 in. in 10 min., which is one revolution in 24 hours. Power weight drop is at the rate of 5¼ in. in 24 hours. The paper drum is removed from the frame for changing the record sheet, and its drive is through a friction disk so that the pencil can be set to the exact time without taking it out of gear.

The recorder was originally designed for the definite purpose of recording fluctuations of water stage in the streams, channels and washes in Los Angeles County, which are dry except during heavy rains. As the use for the recorder was temporary or intermittent, it was the opinion of district engineers that the cost of the more expensive continuous-type instruments at these locations was unwarranted. The operation of the recorder indicates that it will prove satisfactory.

From extended field experience with five makes, nine types and fourteen models of water-stage recorders (the district owns and operates more than 80 water-stage recorders), it has been possible to overcome many causes of trouble and inconvenience in usual installation and operation. In addition to the feature of low cost, the design of the model includes: (1) convenient arrangement for removing and replacing record paper; (2) friction drive permitting the pencil to be set for exact time without taking the drum out of mesh or changing pencil length; (3) point of reversal easily adjusted; (4) minimum lost motion and friction in pencil carriage due to its design; (5) pencil held against record paper and cannot be left out of contact inadvertently; (6) paper drum bearings fixed at one end only, to eliminate binding as a result of contraction or expansion of base; (7) light weight for transporting over mountain trails; (8) low cost of the clock, permitting replacement rather than repair when in bad condition with less loss of time; (9) on a dry channel the pencil follows around the drum on the zero line until flow starts.

After installation of the first recorder of this type at one of the regular stream-gaging stations operated by the district, it is reported that an experienced hydrographer, unfamiliar with the instrument, found it highly satisfactory.

The water-stage recorder, both as to design and construction, is the product of engineers in the hydrographic department of the Los Angeles County Flood Control District under the direction of E. C. Eaton, chief engineer, and H. E. Hedger, office engineer.



Inexpensive recorder is weight-driven through clock movement. Principal features include: (A) pencil-cord drum; (B) pencil carriage; (C) float cable sheave; (D) pencil-cord roller guides; (E) power weight drum; (F) clock for regulation; (G) spring paper clamps; (H) record paper; (I) time change gears; (J) pencil-reversing adjustment screw; (K) pencil-carriage cord.

Nineteen Contracts Under Way on Colorado River Aqueduct

Present construction operations include 126 miles of roads, 390 of transmission line and 178 of water line—Camps opened for 26 miles of Coachella tunnel force-account work—San Jacinto tunnel contract under way—Bids for 22 miles of additional tunnel called

PROGRESS is rapid on the nineteen construction contracts now under way to provide roads, power, communication and a water supply along the route of the Colorado River Aqueduct being built by the Metropolitan Water District of Southern California, and tunneling operations are starting at several locations. Preliminary work has been started on the 13-mile San Jacinto tunnel, the longest bore on the project, and the construction program is being planned to meet the scheduled completion date of this contract—December, 1938. The force now at work on all phases of construction activity numbers about 1,500, and this should increase to 4,000 within the next few months. Contracts have been awarded for constructing 35½ miles of tunnel, and bids have been called on 22 miles of additional tunnel. Plans and programing of the open conduit sections and other features will be made in detail later.

The 239-mile Colorado River Aqueduct is being constructed to deliver an ultimate supply of 1,500 sec.-ft. of water from the Colorado River to the Metropolitan Water District, composed of Los Angeles and twelve adjacent cities in southern California. The general scope of the project and the principal construction features were described by F. E. Weymouth, general manager and chief engineer, in *Engineering News-Record,* June 16, 1932, p. 847. It includes 91.0 miles of 16-ft. horseshoe-shaped tunnel, 65 miles of concrete-lined open canal, 55 miles of concrete conduit and 27 miles of siphons, as well as regulating reservoirs and a pumping system for the 1,600-ft. lift. Financing for the first stages of the work was effected by the agreement of the R.F.C. to take during 1933 and 1934 $40,000,000 of the $220,000,000 bond issue, voted by the district in 1931, for construction of the aqueduct, terminal storage and distribution system. Bonds already sold to the R.F.C. total $6,048,000, estimated to carry the work until June, 1933.

The district's plan for construction includes the providing of communication, power and water facilities along the aqueduct line for the use of all contract and day-labor operations. The main road will have to be supplemented, of course, by additional roads built by contractors to actual points of operation. Power and water supplies will be sold from the main lines. Work on these facilities has been rushed to provide for the start of actual aqueduct construction.

Water supply

Most of the aqueduct route is in a mountainous desert region, where the provision of a water supply presents a serious problem and is a necessary preliminary to any extensive construction activity. In fact, the work done on the Coachella tunnels has been carried on with a water supply hauled in tank trucks pending the building of the supply line, recently completed. Along the western end of the aqueduct line the existing water-supply facilities or the possibility of developing local wells made it unnecessary to provide a continuous supply line. However, from Morongo Canyon east (Fig. 1) the water-supply system is being built practically continuous for a distance of 178 miles to the Colorado River.

Along this distance ten wells have been developed in the desert, and two at the river with a maximum depth to water of 750 ft. Well casings are 16 in. in diameter, and electric pumps will be provided to raise the water to the line. The system is being developed to meet an estimated demand of 2 m.g.d., and nine reservoirs are provided along the line with a capacity of 300,000 gal. each. They will be of the circular excavated type, gunite-lined and covered and screened. The system is closed, and it is not considered necessary to provide for purification. Considering the region, the quality of water is exceptionally good; the wells will provide water having total dissolved solids between 635 and 1,100 p.p.m.

From Morongo Valley to Mecca Pass (Fig. 1) two contracts are being carried forward involving the trenching and laying of 33 miles of line consisting principally of 5- and 6-in. lightweight gas-line type of pipe with welded joints. These contracts involve about $18,000, and the work is practically

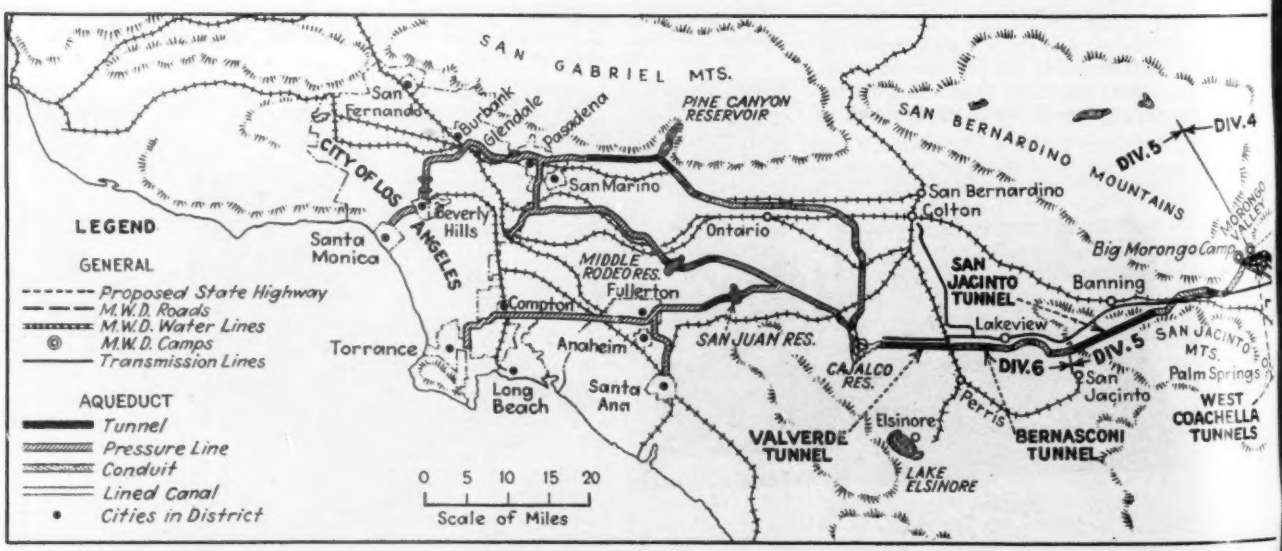


Fig. 1—Water supply, power and transportation facilities have to be provided along the 239-mile aqueduct line over mountain and desert, to make possible the permanent construction operations.

Fig. 2—Typical highway location and grading operations along the desert route of the Colorado River Aqueduct.

complete. Wells at the west end of the line feed into the main, and the supply is pumped as far as Mecca Pass by a booster station.

East of Mecca Pass to a point east of the Iron Mountain tunnel, a distance of 85 miles, a contract has been let for the water line and facilities ($57,000), and the work on this section is well advanced with completion scheduled for July.

Contract has also been awarded for construction of the eastern section of the water-supply system extending from the east portal of the Iron Mountain tunnel to the river, a distance of 60 miles.

Highway

To provide a suitable type of road to reach the numerous points of attack on construction operations along the aqueduct line requires about 150 miles of primary highway in addition to secondary roads to be built by contractors. Of this road program, 121 miles is already under contract. Specifications call for a 20-ft. width of road-mixed surfacing, with a minimum thickness of 3-in. oil cake and 6-ft. shoulders. Existing roads have made it unnecessary to provide any additional highway for the section west of the Coachella tunnels.

Beginning at the west end of the Coachella tunnels, a contract for $132,000 provides for the main road to Berdoo Canyon. Grading of this section is practically complete, and oiling is in progress.

On the adjacent section of the work to the east no road is being constructed at this time because of the probability of an adjacent state highway relocation. On the section from Desert Center to the river four contracts involving about $400,000 have been let, and work is well along with the date of completion scheduled for July.

Power line

Feeding from existing utility facilities at Colton, a primary 66-kv. transmission line will be constructed to provide electric power for all construction operations. This line will not be part of the final permanent transmission line to be built from Hoover Dam to the pumping plants on the aqueduct. From the primary line a 33-kv. secondary will parallel the aqueduct line more closely, and substations will make power available for construction at 2,300 volts. The type of power-line construction is standard, involving wood poles with crossarm design varied to meet conditions. Where the primary and secondary parallel, the two are carried on the same pole line and otherwise a separate 33-kv. line is built. Total transmission-line construction includes 162 miles of 66-kv. line and 229 miles of 33-kv. in addition to the necessary substations.

The primary line from Colton to Cabazon has been completed, making power available for the work now starting on the San Jacinto tunnel. The second section ($99,000) from the Cabazon substation to Hayfield Reservoir site is under contract and about one-half complete.

The section of the work east from Hayfield consists of a 66-kv. line to Granite Mountain substation and then continues with 33-kv. to the river. This contract has been awarded. All power-line construction is scheduled for completion by July 20, 1933.

Miscellaneous features of preliminary construction also include a field-headquarters office building at Banning

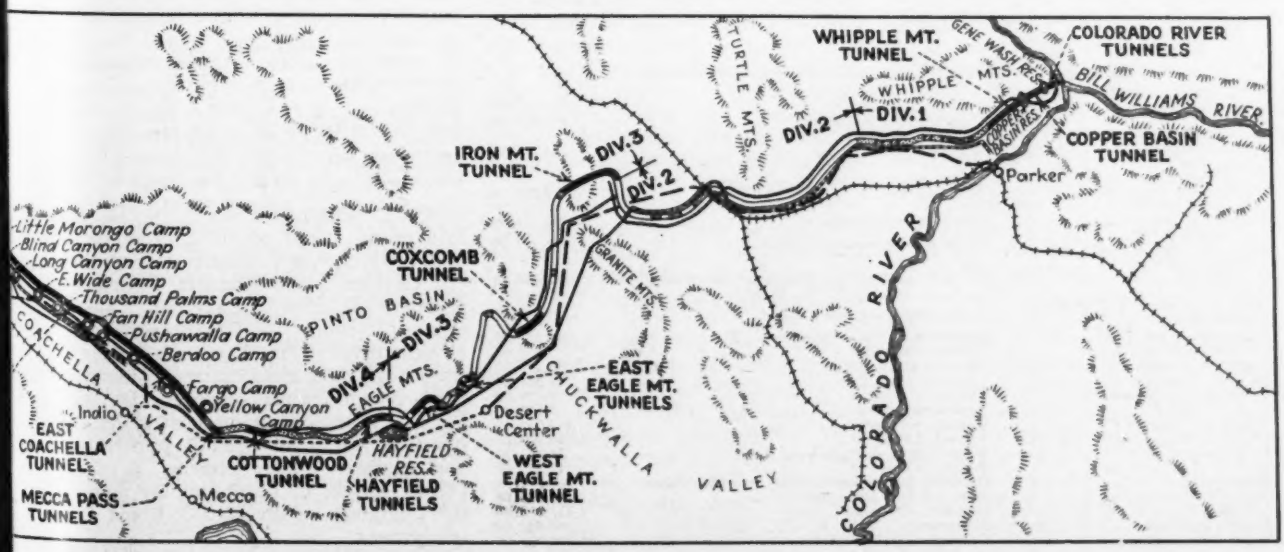


Fig. 3—Thousand Palms camp and environs are typical of the five camps of the district along the Coachella tunnel. Temporary water supply and equipment are used pending completion of permanent facilities.

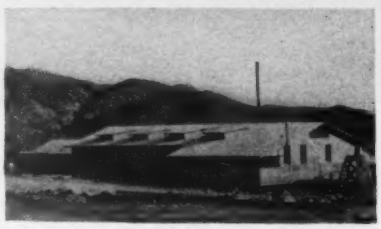


Fig. 4—Mess hall at Coachella Valley camp, showing type of building construction.

Fig. 5—Opening up the west portal of the Thousand Palms section of the west Coachella tunnel.

($36,400), now completed and occupied, and a $5,500 building for a concrete-testing laboratory now under construction. Within a short time a telephone system will be completed along the aqueduct line for construction, to be used ultimately for aqueduct operation.

For the purpose of getting the greatest number of men at work in the shortest time the district decided to carry out 26 miles of the Coachella Valley tunneling operations with its own forces, and work is now under way on camp construction and adit driving. Six camps divide the tunnel into sections about 4 miles long to be attacked from adits or portals. At present this work is being done with temporary equipment until the power and water lines are completed. The following gives data, beginning with the west end of each tunnel.

Camp	Status	Footage to Be Driven: Adit	Footage to Be Driven: Tunnel
Wide Canyon	90% Completed		18,250
Thousand Palms	Completed		23,815
Pushawalla	50% completed	2,750	20,850
Berdoo	80% completed	2,100	28,280
Fargo	Completed	900	27,050
Yellow Canyon	60% completed	675	20,200

Headquarters for this division is located at the Berdoo camp. In general, camp construction is the same, consisting of frame bunkhouses for twenty men with hollow wall design to provide against desert heat. Four-man houses are provided for foremen, and the usual buildings for shop and equipment. Each camp is laid out for a crew of 120.

Work was started at the Fargo camp late in January, and the adit has now been advanced its full length of 900 ft., involving 320 ft. of timbering. Adits are driven 12 ft. wide by 13 ft. high, with full-face operations pulling about 8 ft. per round. At Thousand Palms camp the extensive portal excavation is completed, and the tunnel is about 200 ft. under cover. All of this work is being done with portable compressors and temporary equipment in general until the power line has been completed. The water supply to these camps is hauled by tank pending the finishing of the water system along this section. Men already employed on these force-account operations total 460, and as soon as camp facilities are completed this number will be increased to about 700.

After some delay caused by inability of the low bidder to obtain bond, the contract for the construction of the 67,408-ft. San Jacinto tunnel was consummated with the second low bidder on March 17. The contractor is now accumulating equipment, building roads and starting a camp at the Potrero and Cabazon shafts. This is the longest tunnel of the project, and its scheduled time of completion at the end of 1938 is being taken as the governing factor in laying out the rest of the program.

The Bernasconi tunnel (5,920 ft.) and the Valverde tunnel (37,150 ft.) contracts have been awarded, and both contractors are actively planning camps and equipment. It is probable that the Valverde tunnel will be excavated through four vertical shafts, two of which will be near the ends and two intermediate.

The east section of the Iron Mountain tunnel (23,633 ft.) has been awarded as well as both sections of the Coxcomb tunnel (17,530 ft.). As another contract the west section of the Iron Mountain tunnel (16,172 ft.) has been awarded as well as both portions of the Cottonwood tunnel (20,088 ft.). The tunnels remaining to be awarded follow:

Tunnel	Total Length, Ft.	Bids Called	Scheduled
Mecca Pass (3)	5,700	May 22	1
Hayfield	9,581	May 22	1
Red Butte	9,581	May 22	1
Eagle, East and West	37,880	May 22	3
Whipple Mt.	32,190	June 12	3
Copper Basin	12,280	June 12	2
Colorado River	5,640	June 12	1
Whitewater	10,040	June 12	1

W. P. Whitsett, Los Angeles, is chairman of the board of directors of the Metropolitan Water District of Southern California, and Franklin Thomas, professor of civil engineering, California Institute of Technology, is vice-chairman. F. E. Weymouth is general manager and chief engineer. Julian Hinds is assistant chief engineer. James Munn is general superintendent of construction, and J. B. Bond is construction engineer. John Stearns, R. B. Diemer and B. C. Leadbetter are division engineers on divisions 3, 4 and 5 respectively.

MAJOR CONSTRUCTION CONTRACTS AWARDED

Contractor	Type of Work	Contract Price
John T. Bibb	Field headquarters building	$36,432.00
H. H. Walker, Inc. Newbery Electric Corp. Quality Electric Co.	Transmission line	91,156.00
H. H. Walker, Inc. Newbery Electric Corp. Quality Electric Co.	Telephone line	8,742.10
Morrison-Knudsen Co.	Coachella Valley roads	132,154.75
Geo. Rowland Clark, Campbell & A. J. Callahan.	Water system, sections 6 and 7	18,237.00
A. Teighert & Son C. W. Wood Geo. French, Jr.	Granite Pass Road and Grommet-Earp Road	400,739.50
Clark, Campbell & A. J. Callahan. Ray Schweitzer	Water system, sections 3, 4 and 5	39,581.50
Macco-Robertson, Ltd.	Reservoirs — Water Supply	17,384.00
Hurd & Pickering	Testing laboratory	5,550.00
Wensel & Henoch	San Jacinto Tunnel	7,339,100.00
So. Calif. Telephone Co.	Telephone line	92,000.00
Pacific System Homes, Inc.	Operators' cottages	7,954.00
H. H. Walker, Inc.	Transmission lines	77,560.00
Hamilton & Cleason Co.	Bernasconi tunnel	412,055.00
Dravo Contracting Co.	Valverde tunnel	3,136,603.00
Lang Transportation Co.	Water system, sections 1 and 2	24,217.50
So. Calif. Telephone Co.	Telephone lines	12,500.00
Winston Bros. Co.	Coxcomb Tunnel and east half Iron Mt. Tunnel	3,768,314.35
Utah Construction Co.	West half Iron Mt. Tunnel	1,699,705.00
J. F. Shea Co.	Cottonwood Tunnel	1,857,062.00
Bennett & Taylor	Substations	69,442.00
Water District Forces	Coachella Range Tunnels	18,000,000.00

Elevated Storage at Louisville Cuts Peak-Hour Pumpage

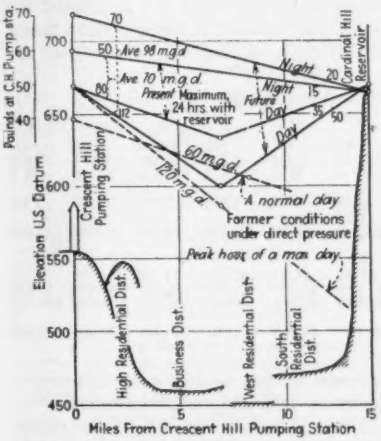
ELEVATED storage in the water-distribution system of Louisville, Ky., provided by recent construction, has eliminated excessive hourly pumpage peaks and increased the capacity of the pumps and distribution arteries about 50 per cent. The pumps now run at a nearly uniform rate day and night.

Up to 1930 the maximum day's pumpage was 63 m.g.d., with 83 m.g.d. as the rate for the peak hour. In 1930, with average annual rate not exceeding normal, the maximum day was 71 m.g.d., and the maximum hourly rate was 116 m.g.d., a peak-hour increase of 40 per cent. Higher outlying consumers were without service, and the pumping capacity reached the maximum from 50 to 60 lb. The average head pumped against is 25 per cent more than formerly, but uniformity has prevented an increase in coal consumption.

The reservoir is 398x511 ft. in plan and has a 20-ft. water depth. It has a flat bottom and roof of column-and-slab construction covered with 1 ft. of earth. Side walls are treated as vertical beams restrained at top and bottom. Horizontal steel (0.4 per cent) is provided for temperatures. Copper strips were used at the end of each day's deposition of concrete. No other provision was taken in design for expansion and contraction, but special precautions were taken during construction to minimize temperature changes. All flat surfaces were flooded after deposition of concrete, and all walls were sprayed from a system of piping inside and outside until earth embankments were placed and the roof was covered with earth. Hair cracks, which were expected, were cut out by machine ¼ in. wide and 1½ to 2 in. deep, calked with oakum and lead wool and finished with cement mortar containing iron waterproofing. The cost of this treatment was $450. The total cost of the reservoir was $329,886.

Tests of the reservoir, which was filled slowly, indicated ⅛-in. loss in depth the first day, ⅛-in. loss the second day, and ⅛-in. loss total in the next six days.

Savings of 16 per cent in cost and the local advantage of freedom from tuberculation led to the use of reinforced-concrete pipe. Tests showed a leakage of less than one-third of the specified allowance of 100 gal. per day per mile per inch of pipe diameter.



Typical hydraulic grade lines between Crescent Hill pumping station and 28-m.g.d. storage reservoir.

safe delivery with one unit out of service. Studies of relative costs of additional pumps and pipes for elevated storage led to the adoption of 28 m.g. of storage at Cardinal Hill, 14 miles from the Crescent Hill station, with the central business section lying between.

The practical effect of the new reservoir together with 8 miles of 4- and 5-ft. reinforced-concrete pressure pipe was to permit the city to be fed from two opposite directions during peak consumption. The hydraulic effect is as shown on the diagram, presented by Charles B. Burdick, consulting engineer, Chicago, in a paper given recently before the Illinois section of the American Water Works Association, from which these notes are taken. When operating under direct pressure, it was customary to drop the Crescent Hill pressure to 40 lb. on normal days and at night, increasing it to 50 lb. during the daytime when required. With the reservoir in service, the pressure varies

Treated Timber Makes Good Record in M. & O. Railroad Bridges

MANY EXAMPLES of the life of treated timbers in railroad bridges were given in a paper presented recently to the Chicago convention of the American Wood Preservers Association by H. Austil, bridge engineer, Mobile & Ohio Railroad. Some of these instances are noted below.

Timber salvaged from a twenty-year-old creosoted ballast deck trestle at Wycliffe, Ky., in 1925, was re-used and is still in service. In 1930 two creosoted ballasted deck trestles at Henderson, Tenn., which were built in 1905, were rebuilt because the grade had been raised and the design was too light. All of the original piling and timber was still in place and sound.

The oldest treated wood on the Mobile & Ohio Railroad is the piling in a trestle over Bayou Coden, which was driven in November, 1899. There are eleven bents of four piles each in this trestle. The details of the treatment are unknown. Being in salt water, these piles were attacked by marine borers between mean tide level and the mud line; and in the summer of 1921 they were protected by pieces of sheet metal bent about them, the rings being filled from mud line to mean tide level with concrete.

In 1914 and 1915 the Mobile & Ohio replaced the untreated framed trestle approaches to the Warrior River Bridge at Tuscaloosa, Ala., with creosoted ballast deck pile trestles. The north approach has 2,060 ft. of trestle, with 166 pile bents of six piles each. The south approach has 928 ft. of trestle, with 75 pile bents (69 of six piles and six of seven piles). The height in general varies between 32 and 45 ft.; but at one place, where a narrow ravine is crossed, it is 70 ft. The old trestle was double and triple deck, and the estimated cost of maintenance was $5,780 per year. It was estimated that the new trestle would cost about $78,600, and the management was assured that it would last fifteen years.

The specifications called for 12 lb. of creosote per cubic foot for both piles and timber. Curb timber, stringer and caps were sized and bored prior to treatment. To date, 75 piles have been spliced, and four additional piles have been driven in the bank bents. This is 5.44 per cent of the original piles. Fifty-six caps, or 23.27 per cent of the total, have been renewed. Twenty-seven braces were renewed on account of a cyclone that blew parts of houses through the trestle and broke the braces. Otherwise all of the original timber is still doing service, and no defective stringers have been found. An inspection in September, 1932, showed 67 defective piles now in this trestle.

The large number of caps renewed is attributed more to the design than to the quality of timber or treatments, there being six ⅞x22-in. drift bolts through the cap and into the pile heads, and eleven ⅞x22-in. drift bolts through the stringers and into the top of the cap, or seventeen drift bolts along the center of the cap in a length of 14 ft.

When the south approach was being built, a pile of freshly treated timber caught fire from a live spark, and some of the 3x10-in. bracing that was badly charred was used in the trestle. Most of this bracing is now partly decayed.

Engine Using Sludge Gas Drives Sewage-Plant Blower

Heat contained in engine cooling water and exhaust gases is utilized to heat sludge in digestion tanks

By W. B. Walraven

District Engineer, Springfield Sanitary District, Springfield, Ill.

AT THE activated-sludge treatment plant at Springfield, Ill., a gas engine that uses sludge gas as fuel has been installed to drive a blower supplying compressed air to the aeration tanks. Heat in the engine cooling water and in the exhaust gases is used to heat the sludge-digestion tanks. Tests recently conducted on the new installation indicated that 81.7 per cent of the heat units in the gas were returned as useful work or as heat supplied to the digestion-tank heating system.

The vertical gas engine has six 9x11-in. cylinders and is rated at 177 indicated hp. at 514 r.p.m. with 65 lb. mean effective pressure. It drives a positive-dispacement blower designed to deliver 3,300 cu.ft. of air per minute against a discharge pressure of 8.5 lb. per sq.in. The engine cooling water and the exhaust gases pass through a water heater. Circulation is provided by centrifugal pumps that force the water through the water jacket, through the heater and then through coils in the sludge-digestion tank.

Prior to the purchase of the gas engine the blower was electrically driven. Comprehensive tests were made on this blower and also upon two other similar units at the sewage-treatment plant, to determine the power consumed in compressing different volumes of air under varying pressures. The motor efficiency was assumed to be 90 per cent, the figure furnished by the motor manufacturer.

Fig. 2 gives a comparison between the power required to operate the blower at different speeds and the ability of the engine to furnish that power. As mentioned in a previous paragraph, the maximum allowable mean effective pressure was arbitrarily set at 65 lb. per sq.in. It will be seen that the power characteristics of the engine lie above and parallel to the blower-power characteristics. As a matter of fact, this was perhaps the most important single factor governing the selection of the engine. Since the motors on the two electrically driven blowers will be at maximum capacity when the discharge pressure reaches 8.5 lb. per sq.in., the gas engine is regarded as having ample power capacity.

Inasmuch as the engine tests were conducted on different days it was found necessary to determine the heat content of the gas during each test. As was expected, the value of the gas varied considerably, ranging from a minimum of 533 to a maximum of 627 B.t.u. per cubic foot. The tests showed that the heat available in the gas was utilized to the extent of 81.7 per cent, as shown in the following:

	Per Cent
Returned as work	21.0
From engine water jacket	42.8
Recovered by exhaust heater	17.9
Total heat recovery	81.7
Radiation, friction and exhaust-gas losses	18.3

Table I gives calculations made for the purpose of arriving at a figure representing the gross annual savings that may possibly result from the installation of the gas engine and other incidental equipment. However, they do not represent net savings, which can be determined only after supplying a factor to represent the percentage of time during which the units will be in actual service and by deducting items for interest, depreciation and operation charges.

TABLE I — TEST RUNS ON GAS ENGINE

Test No.	3	4	1	2	6	5
Rev. per min.	305	307	327	385	390	420
Cu. ft. of air per min.	2,240	2,250	2,400	2,820	2,860	3,080
Brake hp. to blower shft.	87.0	87.7	94.5	114.1	115.0	124.7
Daily saving in kw.-hr. over motor drive at 90% efficiency	1,730	1,745	1,880	2,275	2,290	2,480
Annual saving in electric current at electric rate of $0.01 per kw.-hr	$6,320	$6,380	$6,860	$8,300	[$8,350	$9,060
Daily cost of coal at $3 per ton and 10,000 B.t.u. per lb. to give equivalent heat salvaged. Furnace at 65% efficiency	$3.42	$3.63	$3.95	$4.53	$4.71	$5.11
Annual value of engine heat salvaged, figured as above	$1,250	$1,320	$1,440	$1,650	$1,720	$1,860
Gross value annually of gas as work and heat	$7,570	$7,700	$8,300	$9,950	$10,070	$10,920
Daily flow of gas in cu. ft. at 600 B.t.u. net value to give equivalent results	41,200	44,200	45,800	51,600	58,300	60,600

To the Springfield Sanitary District the most important single item in the table is the figure for the annual saving in power with the engine running at 307 r.p.m., the speed at which we shall operate most of the time. With the engine running at that speed, 24 hours a day, the saving in current will amount to $6,380 per year with a gas supply averaging 44,200 cu.ft. per day. This figure should nearly be realized in practice.

The table also indicates that the annual value of the water-jacket and exhaust-gas heat will amount to $1,320, which is of interest to us, although it does not represent a true saving, because we were formerly using the gas under our boilers to as great or probably somewhat greater extent. However, it shows that in development of sludge gas for power, the waste heat should be salvaged when there is a need for it around the plant, particularly at the digestion tanks. With coal at higher prices than at Springfield, the saving from this source would be proportionately greater.

Table II shows the cost of the recent construction, subdivided into its component parts.

In determining annual charges an at-

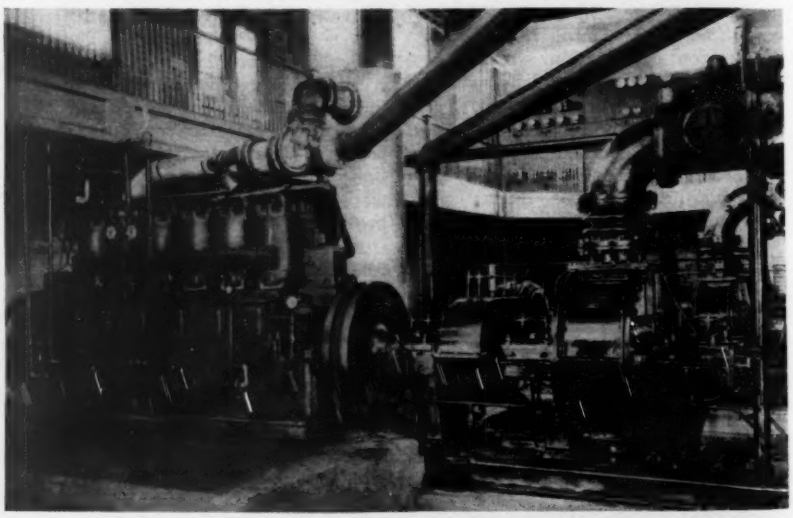


Fig. 1—Six-cylinder engine using sludge gas for fuel drives a positive-displacement blower supplying compressed air for the aeration tanks.

TABLE II — COST OF NEW INSTALLATION

Gas engine and piping	$5,705
Air starting and equipment	288
Exhaust heater	520
Engine base	270
Installation	300
Insulation of boiler, etc	32
Two gas boosters	250
Gas governing equipment	110
Total for engine	$7,475
Gas holder—23,000 cu.ft	$3,365
Floating cover	3,588
Heating coils	1,300
Total for digestion tanks	$8,260

TABLE III — ANNUAL CHARGES

Item	Annual Charge Against Complete Development	Annual Charge Against Engine Development Only
Interest	$708	$336
Depreciation	757	360
Lubricating oil	115	115
Spare parts and maintenance	92	92
Labor of attendance	237	237
Water and miscellaneous	142	142
Total annual charge	$2,051	$1,282

TABLE IV — NET ANNUAL SAVING

Condition	Annual Saving in Electric Current	Annual Value of Heat	Gross Value of Gas	Annual Charges	Net Annual Saving	Per Cent Return on Investment*
Charging engine with all cost of development ($15,735) and omitting value of heat	$5,742	$0.00	$5,742	$2,051	$3,691	27.9
Charging engine with all cost of development ($15,735) but including value of heat	5,742	1,188	6,930	2,051	4,879	35.5
Charging engine with only $7,475 and omitting value of heat	5,742	0.00	5,742	1,282	4,460	64.2
Charging engine with only $7,475 but including value of heat	5,742	1,188	6,930	1,282	5,648	80.0

*Since the annual charges include 4½ per cent interest, this amount is added to the column "Per Cent Return on Investment."

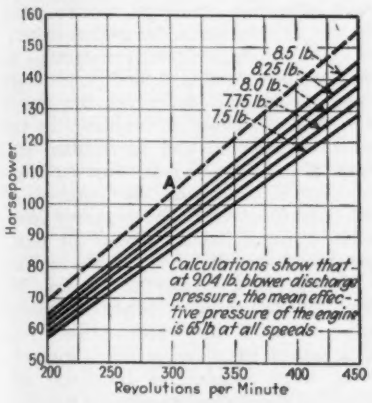

Horsepower
Revolutions per Minute
8.5 lb.
8.25 lb.
8.0 lb.
7.75 lb.
7.5 lb.
A
Calculations show that at 904 lb. blower discharge pressure, the mean effective pressure of the engine is 65 lb at all speeds

Fig. 2—Curves showing relation between blower speed and power required at various discharge pressures. Line *A* shows power developed by gas engine at 65 lb. mean effective pressure.

tempt has been made to arrive at figures approximating as closely as possible the conditions applicable to the Springfield Sanitary District. The several items used, together with a brief discussion of each, are given below:

1. Interest is figured at 4½ per cent per annum, since we can and do borrow on long-term bonds at that figure.

2. Depreciation is figured complete in fifteen years, requiring a sinking-fund rate of 4.811 per cent per annum, although as a matter of fact the units should have some resale or useful value far beyond a period of fifteen years.

3. Since the engine will not be running all the time, we have set the load factor at 90 per cent, believing that we shall certainly equal or better that performance.

4. Labor of maintaining the engine will not exceed seven man-hours a week, or 365 hours a year at $0.65 per hour, or $237 per annum.

Based on these figures, the annual charges against the installation are as shown in Table III. Annual charges are computed, first, on the basis that the cost of the entire development should be charged against the engine, and, second, on the basis that the cost of the engine development only should be considered.

If it can fairly be said that the covering and heating of the two digestion tanks should be a charge against the general treatment plant, then the gas-engine power development has cost the Sanitary District $7,475. If the heating and covering of the two tanks are not essential to the plant as a whole, then the power development should be charged with an additional $8,260, bringing the total to $15,735. It would appear from these figures that almost irrespective of the conditions assumed, the investment will prove to have been wisely made. No one can predict with accuracy what will happen within the next four years, but if the engine holds out for even that short length of time, we shall not have lost any money, even in interest. For every year the engine runs beyond four, and for every year the new floating cover and gas holder are in use beyond that time, the savings will appear as "pure velvet," because the entire investment can be amortized in less than four years.

We do not pretend to know what the actual saving will be, but we do know a few things for certain. Under carefully observed conditions we know that when the engine was running at 307 r.p.m., using sewage sludge gas, the blower compressed 2,250 cu.ft. of air per minute against a discharge pressure of 7.47 lb. per sq.in.; that we put 15,700,000 B.t.u of heat into the sludge heating coils per day, and that the total volume of gas used per day was 42,720 cu.ft. for 24 hours' service, with the gas at 613 B.t.u. lower heating value. We know also that at different speeds and loads the work done and the heat salvaged were in direct proportion to the amount of gas used. Knowing these things to be true, we are willing to leave the more speculative elements to others, with the caution, however, that the percentage of saving indicated at Springfield bears no relation to that which may be accomplished at any other place under conditions prevailing there.

Taxes, Road Expenditures and Travel in Wisconsin

From a survey of finances in Wisconsin as of 1930, the Bureau of Public Roads and the University of Wisconsin arrive at the following summary from an extended report published in *Public Roads* for April, 1933:

The total mileage of highways and streets in Wisconsin in 1930 was 89,539. The state highway system consisted of 10,218 miles, divided into 2,345 miles of primary federal-aid highways, 3,246 miles of secondary federal-aid highways and 4,627 miles of other state trunk highways. The county highway system contained 13,827 miles; the local town roads, 58,934 miles; village streets, 1,567 miles; and city streets, 4,993 miles.

The total volume of traffic (exclusive of out-of-state vehicles) on all roads and streets in Wisconsin during the year 1930 was approximately 6 billion vehicle-miles, of which 52.7 per cent occurred on the state highway system, 13.6 per cent on the county system, 7.9 per cent on town roads, and 25.8 per cent on village and city streets.

The average density of traffic, in vehicles per day, on the state highway system was 801; on the county system, 152; on the town roads, 21; on village streets, 125; and on city streets, 761.

Expenditures on the state highway system in 1930 were $24,918,700, or 0.83c. per vehicle-mile of travel; on the county system, $9,449,100, or 1.23c. per vehicle-mile; on the town roads, $13,910,900, or 3.10c. per vehicle-mile; on village streets, $1,590,000, or 2.23c. per vehicle mile; on city streets, $11,411,700, or 0.82c. per vehicle-mile.

Of the total property taxes expended on all roads, 13.5 per cent was expended on the state highway system; 72.1 on county and town roads; and 14.4 per cent on village and city streets.

Of the total of all taxes and imposts expended on all roads and streets, rural property and motor-vehicle owners paid 46.9 per cent, and travel by rural vehicles made up 31.9 per cent of the total travel on all roads and streets; city and village property and motor-vehicle owners paid 53.1 per cent, and travel by city and village vehicles made up 68.1 per cent of the total travel. These relations between highway taxes paid and travel were no doubt modified by the increase in 1931 of the gasoline tax from 2c. to 4c. per gallon.

Earthquake Damage Analyzed By Long Beach Officials

Grouping all damaged buildings into five classifications and separating old structures from those erected under 1930 code reveals greater inadequacy of old buildings—Basic code changes suggested for existing as well as for future buildings

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and A. C. Horner
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THIS ARTICLE has a particular significance not reflected by its title. In one sense it is the official report of the damage caused in Long Beach by the earthquake of March 10. In all respects it presents the most comprehensive factual information to come out of the earthquake, and gives the only figures available that show the true relation between the number of damaged and undamaged buildings. The analysis of damage given is based on a survey of all buildings irrespective of the amount of damage sustained by each one. It shows that a relatively small per cent was substantially damaged. It indicates that "old code" structures were most vulnerable and that increasingly better code supervision is necessary. In the opinion of the authors, who are well qualified to judge, certain code changes are advisable. These changes are outlined. —EDITOR.

FOLLOWING the Southern California earthquake of March 10, 1933, the spectacular damage revealed in a comparatively few buildings occasioned a demand, voiced largely in the public press, for immediate revision of building laws and for new laws designed to make buildings earthquake-resistant in the future. In large measure this demand was based on conclusions drawn from hastily gathered data. It was evident that before any changes in the building laws could be recommended, the character of the damage to all buildings had to be analyzed.

In order to assist in arriving at a basis for new legislation and to check the adequacy of the existing building code in Long Beach, an analysis was undertaken by the writers, based on the reports turned in by a group of special inspectors, supplemented where necessary by personal inspection of damaged buildings. The group of special inspectors was made up of a number of engineers and architects who volunteered their services and worked under the direction of the Long Beach building department in inspecting damage to individual buildings for the purpose of determining whether or not they were reasonably safe for immediate occupancy. The survey reported herein was not designed primarily for the purpose of learning the reasons for damage to buildings, but rather to disclose the relative degree of damage with respect to: (1) types of construction, (2) occupancy of the building (as it might affect structural security), and (3) the building regulations under which buildings were erected—that is, their age.

Basis of the analysis

All building permits issued in Long Beach from March 10, 1930 (the date when the present code became effective), to Jan. 1, 1933, were examined, and a list was made of all new buildings (other than dwellings and schools) costing over $1,000. One- and two-family dwellings were excluded because of the comparatively large number and because it was believed that their inclusion would not add greatly to the value of the analysis. Schools were excluded because their supervision has been performed by other than city officials.

In assigning a degree of damage to a building the damage classification shown in the accompanying tabulation was used. The classification was developed to meet the requirements of this analysis and is intended to represent the total range of damage experienced by all buildings in the city. The results of this portion of the survey are shown for the 215 buildings erected since March 10, 1930, in Tables IA and IB.

In order to obtain a comparison of damage to buildings erected since the adoption of the present building code with damage to buildings erected prior thereto, the reports of the special inspectors were examined, and the damage to each building was classified. Although these reports did not cover the entire city, they did cover all buildings in the principal business and mercantile sections of the city. By subtracting from this latter tabulation the number of buildings involved in the previous tabulation a list of buildings with the damage thereto was obtained (Table II) for buildings erected prior to March 10, 1930. Some error is doubtless introduced in using this method, but it is unimportant in view of the comparatively large number of buildings involved in the second group.

Character of laws and inspection

Conclusions to be drawn from these data are affected by the code provisions under which the various buildings were built and by the efficiency of inspection that the construction received.

In the past twenty years Long Beach has had three building codes, one adopted in 1913, one adopted in January, 1923, and the present code, which became effective on March 10, 1930. With particular reference to masonry buildings, the 1913 code permitted a straight lime mortar for all walls, except that isolated piers, foundation walls, parapets and chimneys above the roof line were required to be laid up in 1:3 cement lime mortar. During the period when this code was in effect much of the sand used for both mortar and concrete was a dirty fine material comparable to beach sand. The walls were laid up with dry wall and head joints (contrary to code stipulation), and workmanship was decidedly inferior.

The 1923 code required a mortar of 1 part cement to 10 parts of lime mortar, the lime mortar requirements being 1 part lime to 5 parts of sand. Workmanship under this code showed the same dry wall and head joints and was of inferior quality.

EARTHQUAKE DAMAGE CLASSIFICATION, LONG BEACH, CALIF.

	Type I and Type III Buildings*	Type V Buildings*
A	Includes buildings not damaged; buildings showing plaster cracks or other minor damage not affecting structural safety. Parapet walls and brick walls at corners may show cracks but have not been materially weakened. In general, damage to building estimated at less than 3 per cent of value of building.	Includes buildings not damaged and buildings showing plaster cracks which are not indicative of structural failure. Also includes rupture of upper parts of chimneys.
B	Parapet walls thrown down; extensive interior partition damage; rupture of brick or tile filler or partition walls, which will require minor replacements and extensive plaster repairs; separation of veneer from backing; minor damage to structural frame of building.	Exterior wall cracks at or near foundation; extensive chimney damage; loosening of exterior plaster or brick veneer; shifting of porches and other appendages but not of building as a whole.
C	Rupture of masonry walls below roof line; bond failures in concrete; in general, failure of structural parts (walls or frame) necessitating major repairs to or replacement of somewhat less than 50 per cent of exterior walls or framework.	Buildings moved on foundations; general damage to plaster and walls; racking of structural framework, doors, partitions, etc.
D	Extensive damage to walls necessitating replacement of more than 50 per cent of wall area. Corresponding extensive interior damage to partitions, floors, foundations or roof. Failure of structural frame requiring considerable replacement.	General damage to building more extensive than *C* but not requiring complete demolition.
E	Building demolished to an extent making repairs impracticable.	Building demolished to an extent making repairs impracticable.

*Long Beach code classification according to type of construction.
Type I — Fire-resistive (concrete or steel frame)
II — Mill (heavy timber frame and masonry walls)
III — Ordinary masonry (wood joists and masonry walls)
IV — Steel frame (steel framework with incombustible walls)
V — Wood frame (wood framework — stucco, wood siding or brick veneer walls)
The number of Type II and Type IV buildings was so small that they were not included in the analysis.

The 1930 code requires a mortar consisting of 1 part cement, 1 part lime, and 6 parts clean sharp sand. For all isolated piers, mullions and work below ground line a 1:3 cement mortar is required. The workmanship calls for full shoved joints using wet brick. This 1930 Long Beach code is essentially the same as the Uniform Building Code prepared by the Pacific Coast Building Officials Conference.

TABLE IA — EARTHQUAKE DAMAGE TO BUILDINGS OTHER THAN DWELLINGS AND SCHOOLS COSTING OVER $1,000 AND ERECTED IN LONG BEACH SINCE MARCH 10, 1930, WHEN PRESENT BUILDING CODE BECAME EFFECTIVE

(Summarized According to Type of Construction)

Damage Classification	Type I Buildings Steel or Concrete Frame		Type III Buildings (Masonry Walls)		Type V Buildings (Wood Frame)		Total Buildings	
	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
A	7	88	34	44	122	94	163	76
B	1	12	26	34	6	4	33	15
C			14	18	2	2	16	7
D			2	3			2	1
E			1	1			1	1
Total	8	100	77	100	130	100	215	100

TABLE IB—EARTHQUAKE DAMAGE TO BUILDINGS, OTHER THAN DWELLINGS AND SCHOOLS, COSTING OVER $1,000 AND ERECTED IN LONG BEACH SINCE MARCH 10, 1930, WHEN PRESENT BUILDING CODE BECAME EFFECTIVE.

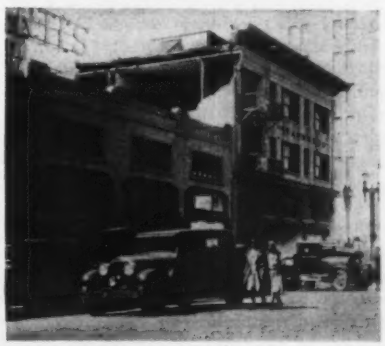
(Summarized According to Occupancies and Types of Construction)

Damage Classification		Apartments, Hotels, etc.			Stores, Banks Offices			Public Garages			Storage Warehouses			Factories, Industrial Buildings			Assembly Churches, Amusement			Total			
		I	III	V	I	III	V	I	III	V	I	III	V	I	III	V	I	III	V	I	III	V	Tota
A	Number		4	72	2	19	25		1			2	2	3	4	12	2	4	11	7	34	122	163
	Per Cent		45	95	67	46	92		9			67	67	100	50	100	100	80	91	87	44	94	76
B	Number		3	4	1	14	1		7				1		1			1		1	26	6	33
	Per Cent		33	5	33	34	4		64				33		13			20		13	34	4	15
C	Number		2			8	1		1						3				1		14	2	16
	Per Cent		22			20	4		9						37				9		18	2	7
D	Number								1			1									2		2
	Per Cent								9			33									3		1
E	Number								1												1		1
	Per Cent								9												1		1
Total	Number		9	76	3	41	27		11			3	3	3	8	12	2	5	12	8	77	130	215
	Per Cent		100	100	100	100	100		100			100	100	100	100	100	100	100	100	100	100	100	100

The character of inspection in Long Beach during the past three years is believed to be comparable to that permitted by the average appropriation of money allowed for building inspection by the average city administration. It is probably fair to assume that the quality of building inspection (considered without regard to personnel) in Long Beach, as in other large cities, has been slowly improving for the past six or seven years.

Older buildings suffered most

Buildings erected according to the provisions of the present Long Beach code withstood the earthquake much better than those erected prior to the adoption of the present code. This was true for every type of construction. A comparison of the figures in Table IA with those in Table II is as follows: Buildings classified as sustaining *A* damage constituted 76 per cent of the "new" buildings (erected since March, 1930) and 45 per cent of the "old" buildings (erected prior to 1930); buildings with *B* damage, 15 per cent of the new and 24 per cent of the old; *C* damage, 7 per cent of the new compared to 20 per cent of the old; *D* damage, 1 per cent of the new compared to 8 per cent of the old; and *E* damage, about 1 per cent of the new compared to 3 per cent of the old. If buildings grouped under the *A* and *B* damage classifications are combined, the survey shows 91 per cent for new buildings and 69 per cent for old buildings. Stated differently, this means that 9 per cent of the buildings erected since March, 1930, suffered damage classified as *C*, *D* or *E*, and that 31 per cent of the buildings erected prior to that date suffered similar damage. Most of the buildings in Long Beach having been erected in the past 25 years, it was assumed that deterioration was not an important factor in the different showing of old and new buildings.



Various types of damage to Type III buildings (masonry walls and wood joists) caused by earthquake at Long Beach, Calif.

Left—*B* damage: parapet wall thrown down; minor damage to structural frame.

Right—*C* damage: rupture of walls below roof line; failure requiring major repairs of somewhat less than 50 per cent of exterior walls or frame.

Below, left—*D* damage: extensive wall destruction requiring more than 50 per cent repair to walls and frame.

Below, right—*E* damage: demolished to an extent making repairs impracticable.

This damage analysis, supplemented by facts gained from personal observation, leads the writers to conclude that the problem of obtaining reasonably adequate public safety in buildings should be resolved in two parts: (1) design provisions for new buildings, and (2) alteration provisions for existing buildings.

New buildings

Viewed from the standpoint of public safety alone, it seems reasonable to assume that new buildings should be required to be so designed that they would not sustain more than class *A* damage. The analysis shows that less than one-half of the buildings inspected in Long Beach escaped with *A* damage.

Considering only the newer buildings, in Table IA, only 44 per cent of the type III structures escaped with *A* damage; this is not a good enough record from the standpoint of public safety.

To confine future earthquake damage in buildings hereafter erected to an *A* classification, it is believed that the minimum requirements are:

(1) Adequate enforcement of an existing building code equal to the 1930 Long Beach code.

(2) An ordinance requiring that all new buildings be designed for a lateral force approximating that induced by an earthquake having an intensity equal to the maximum earthquake recorded in similar geologic and geographic regions.

(3) Additions or revisions to existing building codes, such as the present Long Beach code, covering certain specific details of construction.

There is abundant evidence to show that otherwise well-designed and constructed buildings in many cases were seriously damaged because lateral forces were given no consideration. The practical aspects of building-law enforcement lead the writers to believe that the enforcement of both the lateral-force requirement and the specific requirements as to details of construction are necessary.

Existing buildings

Existing buildings in seismically active areas should be examined, and all parapet walls, ornamentation or other objects found to be inadequately supported or attached to the building should be removed or otherwise made safe. It may reasonably be assumed that such action, had it been taken in Long Beach prior to the March 10 earthquake, would have resulted in a different damage classification, i.e., a change from *B* to *A* for all types I and III buildings surveyed. The percentages of *A* and *B* damage for all buildings of these types, regardless of age, are 17 and 30 respectively. From this we may deduce that if *B* damage could be eliminated, 47 per cent of all now existing types I and III buildings might be considered reasonably safe in a future earthquake of similar intensity.

TABLE II—EARTHQUAKE DAMAGE TO BUILDINGS, EXCEPT DWELLINGS AND SCHOOLS COSTING OVER $1,000 AND ERECTED IN LONG BEACH PRIOR TO MARCH 10, 1930, THE DATE OF ADOPTION OF THE PRESENT BUILDING CODE

Damage Classification	Type I Buildings (Steel or Concrete Frame) Number	Per Cent	Type III Buildings (Masonry Walls) Number	Per Cent	Type V Buildings (Wood Frame) Number	Per Cent	Total Buildings Number	Per Cent
A	29	45	232	14	1,268	73	1,529	45
B	19	29	476	30	332	19	827	24
C	15	23	556	34	105	6	676	20
D	1	1½	274	17	10	1	285	8
E	1	1½	85	5	14	1	100	3
Total	65	100	1,623	100	1,729	100	3,417	100

These figures serve to call attention to the pressing necessity for legislation affecting existing buildings. Replacement and repair due to obsolescence and deterioration may be expected to bring about gradually some improvement in the situation. For a few years, however, the existing-building problem is the hardest one to meet, and the minimum attempt should include the strengthening of parapet walls, ornaments and other similar semi-detached portions of buildings, combined with such alterations to street fronts of buildings as are necessary to make both the exits and the adjoining streets safe for use.

Specific code charges

Notwithstanding the better performance of buildings erected under the present Long Beach code, certain revisions and additions to this code and to other similar codes are desirable and necessary, in addition to a lateral force requirement. The mortar used should be a rich cement-lime mortar approximating 1 part of portland cement to ½ part of lime putty to 4½ parts of clean sharp sand. All joints in unit masonry should be solidly filled with mortar, and each masonry unit should be thoroughly wetted and shoved into place. Header courses should be required in at least every fourth course, and this should apply to veneering and face brick as well as to the backing. Careful consideration should be given to the approval of any types of ties, other than header courses as above suggested, for some methods of anchorage now permitted will not adequately resist earthquake stresses; this is particularly true of ties for masonry veneer on wood-frame buildings.

Hollow walls of masonry, clay tile, concrete blocks and similar construction, whether in bearing walls or in panel walls, should be required to be reinforced with steel in all but the small one- or two-story dwelling. Masonry around and above openings should be tied to the steel lintels.

Careful consideration should be given to anchorage of floor and roof systems to walls. The usual form of joist anchor installed on every fourth joist has proved inadequate. Roof trusses should not only be required to be braced vertically between trusses, but there should be an adequate system of horizontal X-bracing in the plane of the lower chord. Reinforced horizontal belt courses at all floor and roof levels and reinforced vertical ties at the corners and at proper intervals between should be required. Masonry arches should be avoided. The height of parapet or other walls laterally unsupported at the top should be restricted, and such walls should be reinforced and surmounted by horizontal ties of steel or concrete.

Chimneys should be required to be reinforced from the foundation continuously to the top. Wood-frame and steel-frame buildings should be fastened to the foundations with suitable anchor bolts. Where underpinning is used in wood-frame buildings between the first floor and the foundation, it should be diagonally braced in both directions. Clay roof tile should be required either to be wired or nailed to the roof sheathing.

A study of Table IB will indicate some interesting trends, although the number of buildings surveyed hardly justifies any conclusions regarding additional legislation.

Conclusion

The results of this survey indicate that 53 per cent of all existing buildings may be damaged in a future earthquake to an extent equal to *B*, *C*, *D* or *E* damage. The minimum action recommended herein as to existing buildings would result in the elimination of *B* damage in future earthquakes, which would reduce the 53 per cent to 30 per cent. Even this leaves much to be desired from the standpoint of public safety. The ideal objective would be to confine all future damage to such as is included in the *A* classification. To do this would require the complete removal of some existing buildings and more or less extensive reinforcing of others. This would involve such an enormous expenditure in seismically active areas that there seems to be little hope of reaching the objective, although a bond issue for such a purpose has been suggested in Long Beach.

The reduction of *B* damage, which could be brought about by applying the minimum suggestions referred to above, involves comparatively little expense and should be given at least as much attention as the preparation of new laws providing for earthquake safety for new buildings.

If the legislation outlined above is enacted and enforced, there should be no loss of life or serious injury to persons or property from failure of buildings ***hereafter erected*** in any future earthquake, the intensity of which does not exceed the intensity of those that have occurred in Long Beach, Santa Barbara and San Francisco.

Public-Works Bill for National Recovery

Principal provisions of the proposed legislation through which the federal government will build and will assist states, cities and counties to build $3,300,000,000 worth of needed public works —Trade associations prepared for group action

ON MAY 17 President Roosevelt transmitted to Congress the administration's bill covering industry control and a 3½-billion-dollar public-works program. The bill is an emergency measure of two years' duration. It gives the President sweeping powers to carry its provisions into effect, and provides for his appointment of a public-works administrator. In the words of the bill, "any publicly-owned instrumentalities or facilities" are regarded as public works, including highways, water supply, sewerage, flood control, buildings, etc. The bill provides for 30 per cent direct grants to states, cities or counties to be used for materials and labor only in constructing public works, and in addition grants $400,000,000 for state highways, including grade-crossings, making the state highway departments agencies of the federal government in carrying out the latter work. The highway appropriation is not bound by the limitations of the federal-aid highway act. In addition, while the bill provides that the state highway departments *shall* be agencies of the federal government on grade-crossing work, it also provides that the state highway departments *may* be taken over by the federal government for all the highway work authorized, or city or state engineers may be named federal agents for a particular project and so removed from local influence. Minimum wage rates must be established, and a 30-hour week is required, subject to some exceptions. The detailed provisions of the public-works section of the bill are given below.

The President in his message to Congress expressed the view that, "We must by prompt and vigorous action override unnecessary obstructions which in the past have delayed the starting of public-works programs. This can be accomplished by simple and direct procedure." It was left to Congress to propose the tax measures necessary to raise the $220,000,000 estimated to be required for interest and amortization. But this must be done within a few days, for the President is convinced that, "It is urgently necessary immediately to initiate a re-employment campaign if we are to avoid further hardships, to sustain business improvement and to pass on to better things."

The bill is cited as the "National Industrial Recovery Act" and is made up of three titles: Title I, Industrial Recovery; Title II, Public Works; and Title III, Amendments to Emergency Relief and Construction Act of 1932 and miscellaneous provisions.

Industrial recovery

In section 1 of Title I of the bill a national emergency is declared to exist, and it is stated to be the policy of Congress "to promote the organization of industry for the purpose of cooperative action among trade groups, to induce and maintain united action of labor and management under adequate governmental sanction and supervision, to eliminate unfair competitive practices, to reduce and relieve unemployment, to improve standards of labor and otherwise to rehabilitate industry and to conserve natural resources." In outlining the provisions of the bill, Senator Robert F. Wagner, one of its authors, had the following to say relative to Title I, dealing with industrial recovery:

"The purpose of Title I of the bill is to secure cooperative action within industry with a view to eliminating unfair competitive practices, and thereby reduce unemployment, improve standards of labor and otherwise to rehabilitate industry.

"The bill authorizes any group or association within a trade or industry to prepare a code of fair competition which sets forth the standards covering trade and competitive practices within that industry. Such a code is without effect until it is approved by the President.

"The President may approve such a code if he finds:

"1. That the group presenting the code truly represents the trade or industry for which it speaks.

"2. That it admits freely to membership all who are engaged in the same trade or industry.

"3. That the code of rules is fair to competitors, employes and consumers.

"4. That it will not promote monopoly.

"5. That it does not oppress or discriminate against small business enterprises.

"In addition, the employers submitting such a code of fair competition must agree that their employes shall have the right to organize and bargain collectively and that their right to join a labor organization will not be interfered with.

"They must undertake to reduce the hours of labor to that number which the President finds will be most helpful in increasing employment in the industry. Finally, they must agree to pay a minimum scale of wages and maintain minimum standards of working conditions as determined by the President.

"The President is further authorized to enter into or approve agreements relative to any trade or industry with a view to improving conditions within that industry and increasing its power to provide employment.

"The initiative is left with industry. However, should an industry be unable, or refuse to cooperate, the President may impose upon it a code of fair competition and in extraordinary circumstances license the trade or industry.

"Once a code of fair competition is approved or issued by the President, it becomes the standard of fair competition within that trade or industry to which it applies, and all those who comply with it are exempt from the provisions of the anti-trust laws and all those who violate it are subject to legal penalties."

Public works

Title II of the act concerns the public-works program exclusively. This title, substantially in full follows:

Sec. 201—(a) To effectuate the purposes of this title the President is hereby authorized to create a Federel Emergency Administration of Public Works (hereafter referred to as the "administration"), all the powers of which shall be exercised by a Federal Emergency Administrator of Public Works (hereafter referred to as the "administrator") and to establish such agencies, to accept and utilize such voluntary and uncompensated services; to appoint without regard to the civil service laws such officers and employes and to utilize such Federal officers and employes and, with the consent of the State, such State and local officers and employes as he may find necessary, to prescribe their authorities, duties, responsibilities and tenure and, without regard to the classification act of 1923 as amended, to fix the compensation of any officers and employes so appointed.

The President may delegate any of his functions and powers under this title to such officers, agents and employes as he may designate or appoint.

(b) The administrator may, without regard to the civil service laws or the classification act of 1923, as amended, appoint and fix the compensation of such experts and such other officers and employes as are necessary to carry out the provisions of this title; and may make such expenditures as are necessary to carry out the provisions of this title.

(c) All such compensation, expenses and allowances shall be paid out of funds made available by this act.

(d) After the expiration of two years after the date of the enactment of this act, or sooner if the President shall by procla-

mation declare that the emergency recognized by Section I has ended, the President shall not make any further loans or grants or enter upon any new construction under this title, and any agencies established hereunder shall cease to exist and any of their remaining functions shall be transferred to such departments of the government as the President shall designate; *Provided,* that he may issue funds to a borrower under this title prior to Jan. 23, 1939, under the terms of any agreement entered into with such borrower prior to the date of termination, under this section, of the power of the President to make loans.

Scope of works

Sec. 202—The administration, under the direction of the President, shall prepare a comprehensive program of public works, which shall include among other things the following:

(a) Construction, repair and improvement of public highways and parkways, public buildings and any publicly owned instrumentalities and facilities;

(b) Conservation and development of natural resources, including control, utilization and purification of waters, prevention of soil erosion, development of water power, transmission of electrical energy, and construction of river and harbor improvements;

(c) Any projects of the character heretofore constructed or carried on either directly by public authority or with public aid to serve the interests of the general public;

(d) Construction under public regulation or control of low-cost housing and slum-clearance projects;

(e) Any project (other than those included in the foregoing classes) of a character heretofore eligible for loans under subsection (a) of Section 201 of the emergency relief and construction act of 1932, as amended; and if in the opinion of the President it seems desirable, the construction of naval vessels within the terms and/or limits established by the London naval treaty of 1930 and of airplanes required therefor, and construction of such army housing projects as the President may approve. . . . [Subsection (a), section 201, of the Relief Act permits loans to states, municipalities and public corporations for self-liquidating projects; loans to limited-dividend corporations for housing; loans to private corporations for bridges, tunnels, docks, waterworks, canals and markets devoted to public uses which are self-liquidating in character; and loans to limited-dividend corporations for forest development.—EDITOR.]

Basis of financing

Sec. 203 (a)—With a view to increasing quickly employment, while reasonably securing any loans made by the United States, the President is authorized and empowered, through the administration or through such other agencies as he may designate or create, (1) to construct, finance or aid in the construction or financing of any public-works project included in the program prepared pursuant to Section 202; (2) upon such terms as the President shall prescribe, to make grants to States, municipalities or other public bodies for the construction, repair or improvement of any such project, but no such grant shall be in excess of 30 per centum of the cost of the labor and materials employed upon such project; (3) to acquire by purchase, or by exercise of the power of eminent domain, any real or personal property in connection with the construction of any such project, . . . (4) to aid in the financing of such railroad maintenance and equipment as may be approved by the Interstate Commerce Commission as desirable for the improvement of transportation facilities:

Provided, that in deciding to extend any any aid or grant hereunder to any State, county or municipality the President may consider whether action is in process or in good faith assured therein reasonably designed to bring the ordinary current expenditures thereof within the prudently estimated revenues thereof.

The provisions of this section shall extend to public works in the several States, Hawaii, Alaska, the District of Columbia, Puerto Rico and the Virgin Islands.

$400,000,000 for highway

Sec. 204 (a) for the purpose of providing for emergency construction of public highways and related projects, the President is authorized to make grants to the several states (not to exceed $400,000,000 in aggregate amount) as follows:

(1) For expenditure in emergency construction on the Federal-aid highway system and extensions thereof into and through municipalities. The amount apportioned to any State under this paragraph may be used to pay all or any part of the cost of highway construction, including the elimination of hazards to highway traffic, such as the separation of grades at crossings, the reconstruction of existing railroad grade-crossing structures, the relocation of highways to eliminate railroad crossings, the widening of narrow bridges and roadways, the building of footpaths, the replacement of unsafe bridges, the construction of routes to avoid congested areas, the construction of facilities to improve accessibility and the free flow of traffic and the cost of any other construction that will provide safer traffic facilities or definitely eliminate existing hazards to pedestrian and vehicular traffic. In carrying out the improvements to eliminate traffic hazards in connection with railroad crossings at grade, the state highway department shall constitute an agency of the federal government. No funds made available by this title shall be used for the acquisition of any land, right of way or easement in connection with any railroad grade-elimination project.

(2) For expenditure in emergency construction on secondary or feeder roads to be agreed upon by the State Highway Departments and the Secretary of Agriculture:

Provided, that the state or responsible political subdivision shall provide for the proper maintenance of said roads. Such grants shall be available for payment of the full cost of the surveys, plans, improvement and construction of secondary or feeder roads, on which projects shall be submitted by the state highway department and approved by the Secretary of Agriculture.

(b) Any amounts allocated by the President for grants under subsection (a) of this section shall be apportioned among the several states, three-fourths in accordance with the provisions of section 21 of the Federal Highway Act, approved Nov. 9, 1921, as amended and supplemented, and one-fourth in the ratio which the population of each State bears to the total population of the United States, according to the latest decennial census, and shall be available on July 1, 1933, and shall remain available until expended; but no part of the funds apportioned to any state need be matched by the state.

(c) All contracts involving the expenditure of such grants shall contain provisions establishing minimum rates of wages, to be pre-determined by the state highway department, which contractors shall pay to skilled and unskilled labor, and such minimum rates shall be stated in the invitation for bids and shall be included in proposals for bids for the work.

(d) In the expenditure of such amounts, the limitations in the Federal highway act, approved Nov. 9, 1921, as amended and supplemented, upon highway construction, reconstruction and bridges within municipalities, and upon payments per mile which may be made from Federal funds, shall not apply. [The Federal Aid Highway Act apportions the federal contributions as follows: one-third in ratio that the area of the state bears to area of all states, one-third on a similar population ratio, and one-third on the ratio that the rural post roads in the state bear to those in the entire country.—EDITOR.]

(e) As used in this section the term "state" includes the Territory of Hawaii. The term "highway" as defined in the Federal Highway Act, approved Nov. 9, 1921, as amended and supplemented for the purposes of this section, shall be deemed to include such main parkways as may be designated by the State and approved by the Secretary of Agriculture as part of the Federail-Aid highway system.

Wages and work hours

Sec. 205—All contracts let for construction projects and all loans and grants pursuant to this tittle shall contain such provisions as are necessary to insure (1) that no convict labor shall be directly employed on such project; (2) that (except in executive, administrative and supervisory positions), so far as practicable, no individual directly employed on any such project shall be permitted to work more than thirty hours in any one week; (3) that all employes shall be paid just and reasonable wages which shall be compensation sufficient to provide, for the hours of labor as limited, a standard of living in decency and comfort, and, (4) that in the employment of labor in connection with any such project preference shall be given where they are qualified to ex-service men with dependents.

[Section 206 authorizes the President to prescribe rules and regulations; section 207 provides for borrowing to meet authorized expenditures; taxation provisions are to be inserted as section 208.—EDITOR.]

Section 209. For the purpose of this act, there is hereby authorized to be appropriated, out of any money in the Treasury not otherwise appropriated the sum of $3,300,000,000.

Title III—Amendment to Relief Act

Section 301. After the expiration of ten days after the date upon which the administrator has qualified and taken office, (1), no application shall be approved by the Reconstruction Finance Corporation under the provisions of Subsection (a) of Section 201 of the emergency relief and construction act of 1932 as amended, and (2) the administrator shall have access to all applications filed, and records of the Reconstruction Finance Corporation relating to loans and contracts and the administration of funds under such subsections; provided that the Reconstruction Finance Corporation may issue funds to a borrower under such subsections (a) prior to Jan. 23, 1939, under the terms of any agreement entered into with such borrower pursuant to an application approved prior to date of termination, under this section, of the power of the Reconstruction Finance Cor-

poration to approve any such applications.

Section 302 decreases the borrowing power of the R.F.C. and Section 303 is the separability clause and Section 304 prescribes a short title for the act.

Federal Trade Regulations

The provision of the industrial recovery bill by which all industries, through their own organizations, will set up codes of self-government, subject to the government's supervision, dates back for its inspiration more than 10 years to the trade practice conference procedure established by the Federal Trade Commission. Although the codes adopted with the commission's sanction did not convey or imply any modification or suspension of the anti-trust laws, they were useful in translating these statutes into terms of what could and could not be done cooperatively by members of an industry to establish clean competitive conditions.

The codes were useful to the Trade Commission, in the first instance, by enabling it to deal with a whole industry instead of an individual, so that even though the only practices exorcised were those that are clearly unlawful, the codes became an instrument for effective industrial discipline.

Conference procedure gradually expanded to include acceptance by the commission as "expressions of the trade" of resolutions condemning practices not unlawful *per se* but which were uneconomic and undesirable. Although the commission had no power to enforce such rules upon the recalcitrant, the advantage from the standpoint of industry from this enlargement of the scope of the codes rested in the fact that the socalled "group 2" rules were not objectionable from a legal standpoint. When turned against the pestiferous practices of a particular industry, such codes served as a common ground for organizing many industries.

But the trade practice conference procedure wilted suddenly, due to the vacillating policy of the commission in approving the terms of one code and rejecting the same terms in another. The practical usefulness of the codes ended when the commission was apprised of the tendency on the part of some industries to apply the codes in such a manner that, in practice, they looked suspiciously like unlawful restraints of trade.

An abortive attempt was made to fortify the system by legislation. Eighteen months ago the proposal was made in the Nye bill to legalize agreements reached under Trade Commission auspices to eliminate unfair and uneconomic practices. Under this bill the members of an industry would be immunized from anti-trust prosecution on the condition that they would suspend operation of any code if and when revoked by the commission. Congress balked at this implied modification of the anti-trust laws and it is this feature that is drawing the most opposition to the industry control bill today.

Quick action under the provisions of the bill may be expected from the many organizations in the construction field whose activities will be materially affected by Title I of the bill. Already many of them have prepared tentative codes of practice that can be adapted to the requirements of the bill. Likewise, the men upon whom the burden of getting public-works projects under way, state and city engineers, state highway engineers and directors of public works, are ready to inaugurate proceedings to obtain the loans and grants of Federal funds provided under the public-works section of the bill as soon as it is passed.

Specific examples of what may be expected from these public officials and associations in the construction field are given in the following replies to telegraphic inquiry to key men in the associations, to engineers in close contact with public work in important centers of public construction, and to men in close touch with the producers of construction materials.

Contractors ready

Speaking for the Associated General Contractors of America, A. C. Tozzer, president, states that, "The Industrial Recovery and Public Works Bill now pending in Congress meets with the whole-hearted approval of this association. I believe it constitutes the most practical and far-reaching forward step toward business recovery yet advanced. I feel sure that contractors can work out effective codes of practice for their branch of construction by an extension of trade practice conditions for which the A.G.C. has been struggling for many years. This association, representing a membership of 1,500 leading construction firms, welcomes the opportunity to try its hand at eliminating irresponsible and cut-throat procedure from our industry. We are already preparing an outline of trade-practice rules. We shall do all we can in support of this forward-looking measure and ask the cooperation of other agencies and organizations in the industry in order that delays in launching this vital unemployment relief program may be avoided."

Construction machinery

Formation of effective organizations of the construction machinery manufacturers is complicated by widely divergent lines of activity which interest the several groups, but replies to telegrams to the leaders in that field indicate a decided trend toward a central equipment association with sub-groups to function in each particular field. For example, the shovel and crane industry is partly organized at the present time and could easily complete its organization as a sub-group with a code of practice to meet its special requirements.

A few years ago the concrete-mixer industry set up a code of practice on many things vital to its members such as trade-ins, selling machines below or above rated capacities, etc., but the Federal Trade Commission so emasculated it that it became of little use. Under the proposed liberalization of the law under which the commission acts this could be made the nucleus of a sub-group code.

Cement

An organization adaptable to the purpose of the industry control bill, the Cement Institute, has been in existence for several years, and it is ready to be developed to serve as the point of contact with the government under the recovery bill to represent the cement industry throughout the United States.

The institute some time ago drafted a code of ethics. As this was fitted to the local requirements then existing, it will require expanding to serve the objectives of the industry control bill, but it is expected that this can be done rapidly and effectively as the organization is already in existence.

Steel

Charles F. Abbott, executive director of the American Institute of Steel Construction states:

The steel constructors of the United States in 1929 adopted a code of trade practice. That code was considerably emasculated by the Federal Trade Commission, which conceived its duty to be to limit the proposed rules to only those points covered by the anti-trust laws. Prior to this the institute had adopted a code-of-standard practice, including a uniform sales contract that is calculated to eliminate trading in the terms of a sale. It is our belief that were our industry permitted to put these codes rigidly into effect today, holding the non-cooperators to their terms, we would eliminate most of the present evils of cut-throat competition.

At White Sulphur Springs, W. Va., in 1931, our institute also voted on a plan to rationalize the steel construction industry. Under that plan all available work would be automatically distributed to the units in the industry in accordance with their capacities by imposing a graduated tax on those concerns which take more than their proportion of the contracts in any month. Under such a plan it is believed our industry could quickly revert to a more equable basis and be in a position to pay better wages. It is our belief that any plan that permits the payment of higher wages will enable the industry to employ more men, for obviously the higher the unit of wage the further we can divide the jobs without asking any workman to serve for starvation compensation.

This industry has not as yet taken any steps under the proposed industrial control act, but with this background we are prepared to take action tomorrow, or just as soon as it seems reasonable to expect the bill to become a law.

The National Lime Association, according to Norman G. Hough, president and general manager, had a trade-practice conference a few years ago and has the machinery still in existence to swing into action.

Lumber and brick

Wilson Compton, manager of the National Lumber Manufacturers Association, states that the forest industries foresaw the liberalization of government control and some time ago began to

devise means of adapting themselves to it. He states:

For many years the lumber industry has been endeavoring to find a solution of the baffling problem of orderly production and distribution in its own business. Owing to the nation-wide distribution of sawmill plants and the 15,000 proprietary individuals and companies, exceptionally independent and individualistic in their business principles and practices, it has long been evident that some sort of governmental assistance was necessary, chiefly in respect to modification of the anti-trust laws. As a step in this direction, the U. S. Timber Conservation Board was established under Presidential sanction in 1930, but no legislation has yet resulted from its salutary recommendations.

The industry, therefore, sees in President Roosevelt's Industrial Recovery Act not only a welcome opportunity to meet the effects of the depression but to inaugurate a permanent system of planning and coordinating its affairs. Besides many informal conferences in the last month, as well as participation in inter-group conferences to shape the Industrial Recovery Act, we had a meeting of lumber association officials of the West, South and North in Washington on May 20 and will hold an inter-regional conference of spokesmen of principal forest-industry groups throughout the United States at Chicago on May 25. We have informed the President that we expect to have ready before the end of June a coordinated series of codes of fair competition in cordial harmony with the spirit of the act.

We propose to ask the President or the administrator of the act to treat the fair competition coordination of the lumber industry as primarily a national problem. With our present organization of the manufacturing side of the industry into regional groups and the National Lumber Manufacturers Association, which has also direct membership, we have the framework of an efficient and effective cooperative administrative organization.

Speaking for the Brick Manufacturers Association of America, Ralph P. Stoddard, secretary-manager, states:

The association has been preparing itself to take advantage of the administration's partnership with industry at the earliest opportunity. As far as the Wagner Bill indicates the duties of the trade association, in connection with recovery of industry legislation, we have made preliminary preparation.

Representing as we do the manufacturers of building brick from coast to coast, and being the sole organization of manufacturers of that grade of brick known as common in this country, we have not one blanket problem but a score of local situations to solve. Our first step was to get an expression of the needs in the different sections from our members in those sections. We asked for suggestions as to methods and the basis for arriving at required production, proportioning of the volume, minimum retail price based upon cost of production, convenient hours of employment and wage scales.

Until developments indicate our error, we will assume that this national association will present for the President's approval the principals of a national code of business practice for the industry, and that this association will transfer its authority to its local groups of members who will agree upon the details of the plan affecting their market area.

Costs of production vary widely in different sections and the cost of labor is not the only variable. The workability of the natural clays, the time required for firing the brick and cost of fuel are different. It costs more than twice as much to make brick in New England as in some parts of the South.

We are urging every non-member manufacturer of brick known to us to have a voice in suggesting the industry plan and code. It is not our desire to leave anybody out or punish anybody, but to secure the most complete cooperation of the entire industry possible. The association membership now represents about fifty per cent of the producing units of the industry and more than fifty per cent of the production capacity.

Quickly available work

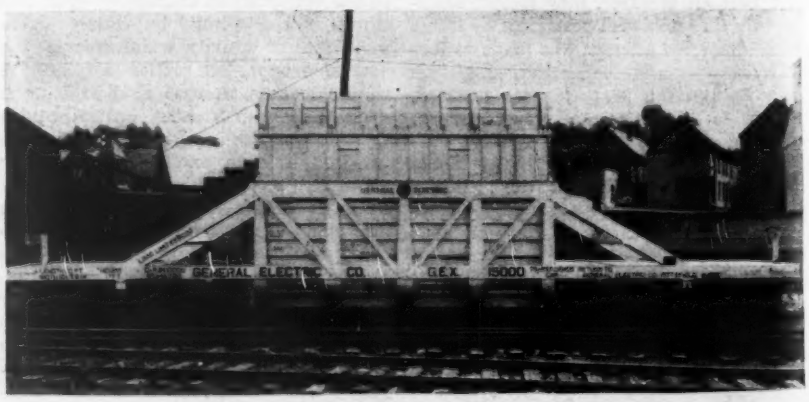
Inquiries addressed to city or state engineers, to state highway engineers or director of public works at widely separated points throughout the country indicate that the missionary work done by the committees for trade recovery or by special state committees set up to seek out needed public works has resulted in the drafting of many programs of work, some of which can be put under construction within a few weeks of the organization of the administration called for in the public-works section of the recovery bill. State highway departments are especially fortunate in this respect. For example, the Missouri state highway department has $18,000,000 of highway work that can be started as soon as bids are received, and the Colorado highway department can let $750,000 worth of work as soon as the money is assured, can let $1,500,000 within three weeks and can prepare plans for a like amount each month thereafter. California has in excess of $20,000,000 worth of highway work ready to go, Massachusetts can let $4,000,000 worth in 30 days and $3,500,000 at the end of 60 days, and Ohio has $10,000,000 ready within 30 days and $10,000,000 more within 60 days. In South Carolina plans for from $5,000,000 to $7,000,000 worth of work are ready, New York has $10,000,000 ready and plans for more are under way, and Virginia also can start $10,000,000 worth of highway work with the passage of the bill.

Unique Welded-Truss Rail Car Developed to Haul Heavy Transformers

TWO NEW CARS developed for the transportation of heavy transformers have recently been built and put in service by the General Electric Co. With the exception of the trucks, the cars are of arc-welded construction throughout. Each car weighs 141,000 lb. empty and was designed for a load of 260,000 lb., although during tests a load of 282,000 lb. of pig iron was successfully carried. As shown in the illustration, the car frame consists of a Pratt truss "bridge" carrying a ⅜-in. steel-plate tank in which the transformer core and coils are placed. The tank is filled with gas at 5-lb. pressure to exclude any moisture.

The bottom chords of the Pratt trusses extend the full length of the 60-ft. car and take the full buffing force, acting as columns between the draft-gear backstops. The end posts of the trusses intersect the bottom chord at the center plates (between the trucks), where the reactions due to load are applied. The verticals, which are I-sections built up of plates, are continuous from the top chord of one truss to the top chord of the other truss, forming a cradle in which the tank rests on longitudinal floor beams. These verticals are 7 in. wide in the truss and 12 in. wide under the tank. The tank floor, a 1-in. plate, forms the top flanges of the cradle members and of the longitudinal floor beams. By making all members from welded plates, a considerable weight saving was effected, since cross-sections could be varied to suit the loads.

Transformer car is a welded Pratt truss "bridge" carrying a tank in which the core and coils are placed under a 5-lb. gas pressure to exclude any moisture during shipment.

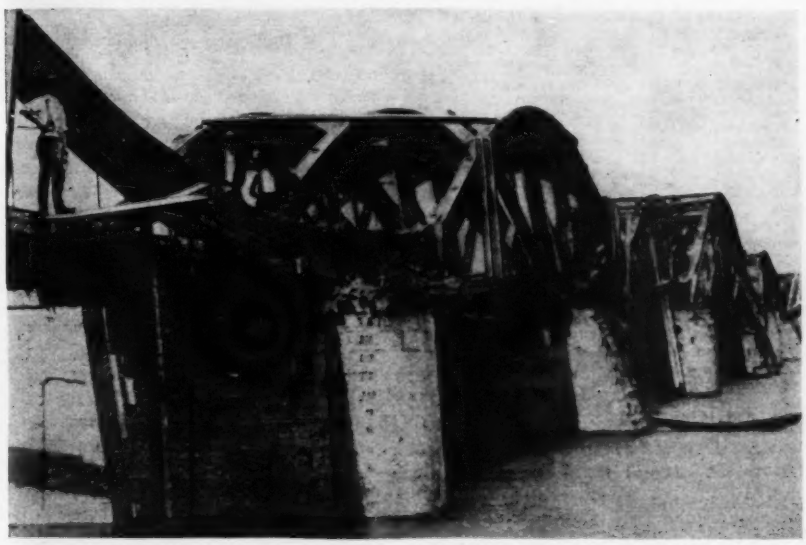


Letters to the Editor

A Unique Pioneer Bridge

Sir—Recently the attention of engineers has been directed to early wooden-bridge construction in this country by a historical monograph published in the *Proceedings*, Am.Soc.C.E., for November, 1932, and by the subsequent discussion. The remarkable Mohawk River Bridge at Schenectady, N. Y., is mentioned in this account, but no description is given.

Schenectady was the most western pioneer settlement of colonial days, having been founded by Arendt van Corlaer in 1661, and was an important factor in developing the great trade route through the Hudson and Mohawk valleys westward to the Great Lakes. In those days the Mohawk was crossed by a ferry. In 1800 an ordinance was passed, authorizing the construction of a bridge. This was begun in the following year, but before completion the work was carried away by a flood. In 1805 a new ordinance was passed, and under its authority the wooden bridge shown in the accompanying illustration was built, in 1806-1808, by the Mohawk Bridge Co.



Old timber suspension bridge over Mohawk River at Schenectady, which was built by Theodore Burr in 1806 and removed in 1873. View shows bridge during demolition and after the removal of the barn-like inclosure, common to early old bridges.

This bridge was one of the early designs of the famous New England bridge builder, Theodore Burr. He was a cousin of the equally well-known Aaron Burr, both men of genius, but one noted and the other notorious. In this remarkable structure Burr actually built a suspension bridge of timber. Evidently he was experimenting at this stage of his career, for he developed various types of construction, and subsequently invented the combined arch and truss type, which was not only well adapted to timber construction but also laid the theoretical foundation for the design of steel bridges.

Suspension bridges consisting of a footway hung from ropes or chains have long been known, but the Mohawk Bridge seems to have been the pioneer attempt to construct a timber bridge on this principle. In fact, it antedated by several years the work of Sir Thomas Telford and Sir Samuel Brown in England, who developed in 1814-30 a suspension bridge constructed of iron links. The massive wooden cables were built up of 2-in. planks of Norway pine, overlapping so as to make a continuous cable support, and were each 3 ft. wide by 4 ft. deep. The bridge was 900 ft. long, divided apparently into four spans, supported on masonry piers. Credit for the actual work of construction belongs to David Hersey, a stone mason by trade, who was "boss of the job." After many years of service the bridge became weakened by exposure to the weather and lack of repair, and additional piers were inserted, one under the center of each span, as shown. These may be distinguished from the original piers by their difference in design.

In 1833 the bridge was inclosed by a succession of barn-like structures that converted it into a long, dark tunnel, dimly lighted at night by four oil lamps. In time this ancient weather-beaten structure acquired a quaint picturesqueness that for a generation or more made it a cherished landmark. Like other old landmarks, however, it was forced to give way to the march of events, and in 1872 it was condemned and sold for $12,600 to the town of Glenville, located at the opposite end of the bridge from Schenectady; and in the following year it was demolished and replaced by an iron-truss bridge supported on the original piers. Subsequently the same piers supported a line of trolley tracks adjacent to the bridge structure, until finally the bridge was abandoned with the opening of the new bridge.

STEPHEN E. SLOCUM,
Consulting Engineer.

Ardmore, Pa.,
April 17, 1933.

Washington Monument Facts Corrected

Sir—The opening paragraph of Major Gillette's interesting article entitled "Washington Monument Facts Brought Up to Date" (*ENR*, April 20, 1933, p. 501) is misleading. The second sentence opens with the words: "In 1783 came the first proposal for a monument to General Washington." Presumably this is correct, or would be if "authorization" were substituted for "proposed," but further on the sentence reads, "to be located at the intersection of the north-south axis through the White House and the east-west axis through the Capitol." This brings together as if simultaneously two events, the first of which occurred years before there was a White House and a Capitol.

It was not until July, 1790, that Congress established a permanent seat of government on the banks of the Potomac. Early the next year Major Pierre Charles L'Enfant, a French engineer and artist, who served on the American side in the Revolutionary War, was engaged to lay out the proposed city. In the marginal notes to his "Plan" the first entry was: "*A*—The equestrian figure of GEORGE WASHINGTON, a Monument voted in 1783 by the late continental Congress." The site proposed for this monument, wrote L'Enfant in a report "To the President of the United States" dated June 22, 1791, was "at the point of intersection of the sight from each of the Houses (the Federal House and the Presidential palace)." This location agrees with the one noted by Major Gillette, but it was not designated by L'Enfant until eight years after the Continental Congress authorized the construction of a monument to Washington—not in the city of Washington, for no such city then existed.

Those interested in further details of the original plan for the District of Columbia and the unfortunate experiences of the design in connection therewith may consult "L'Enfant and Washington, 1791-1792," by Elizabeth Kite, Historical Documents Institute Français de Washington, 1929 (reviewed in *Engineering News-Record*, July 17, 1930, p. 105).

M. N. BAKER.

Upper Montclair, N. J.

Book Reviews and Notes

A Monthly Commentary on Current Additions to the Civil Engineer's Library

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Secondary Road Practice

LOW-COST ROADS AND BRIDGES—By Victor J. Brown and Carleton N. Conner. Cloth; 6x9 in.; pp. 544; numerous charts, line drawings, halftones and tables. Published by Gillette Publishing Co., Chicago. $6.00.

Surveys of secondary-road practice, which have accumulated rapidly during the last five years, have been ably organized and presented in this latest volume for the roadbuilders' library. In general, the authors have chosen to give the facts fully as they appeared in the reports drawn upon. This practice makes their book one to be used as a source text for original information rather than as a considered digest of generally accepted practice. Classification and arrangement with an ample table of contents and an index make consultation and reference convenient. The following chapter titles indicate the range of subjects considered: (1) The Design of Local Highways, (2) Economics and Planning, (3) Location, Design and Grading, (4) Untreated Surfaces, (5) Bituminous Surface Courses, (6) Use of Concrete for Low-Cost Road Construction, (7) Materials Manufacture and/or Proprietary Mixes, (8) Interpretation of Tests on Bituminous Road Materials, (9) Equipment and Machinery (10) Maintenance, (11) Low-Cost Bridges and Culverts.

* * *

Timely Advice to Unemployed

THE TECHNICAL MAN SELLS HIS SERVICES—By Edward Hurst. Cloth; 6x9 in.; pp. 239. Published by McGraw-Hill Book Co., Inc., New York and London. $2.

Anything that will assist an enginer in getting a job is welcome these days. This book has that as its sole object. Primarily it is written for the young engineering graduate, for it is from experiences with that group that the author prepared the manuscript. The book, however, cannot but be helpful to the older man in suggesting new methods of approach to his problem. Edward Hurst, the author, is an industrial executive who has made a hobby of helping engineers to find jobs. To put his experiences in concrete form, he has taken ten men, students of Professor X ,and has followed them through the process of selling their services to a prospective employer, Mr. Jones. Specific instructions as to the fundamentals of job hunting are tersely and forcefully set forth in four introductory chapters entitled: A Preliminary Reconnaissance; Closer Scrutiny and Additional Dissection; Contacting Employer Prospects; Interview Technique.

Vocational Guidance

Reviewed by Eugene E. Halmos,
Parsons, Klapp, Brinckerhoff & Douglas, Engineers, New York, N. Y.

VOCATIONAL GUIDANCE IN ENGINEERING LINES—Elicited and Edited by the American Association of Engineers. Editorial Committee: J. A. L. Waddell, chairman, the late Frank W. Skinner, Harold E. Wessman. Cloth; 6x9 in.; pp. 521; photographs. Published by The Mack Printing Co., Easton, Pa. $2.

THE main object of this book, according to the editors, "is to obtain, for technical institutions students of the best possible type, and to exclude therefrom by frank discouragement most of the usual unfit applicants for admission, whose name, unfortunately, is legion." The main divisions of engineering are covered in the first section of the book and the second section contains 40 chapters devoted to the principal specialties of the several main divisions, all written by men selected from among the leaders of the engineering profession. An editorial résumé and conclusions are given in the last chapter.

The need for a book such as this has been apparent for many years as our colleges became more and more crowded with aspirants for higher education, particularly in engineering lines, since the conclusion of the World War. The present volume is the outcome of the American Association of Engineers' search for ways in which it might be possible directly to reach young men aspiring to be engineers. The result is truly remarkable. The editors and the contributing authors have produced a book on engineering which from the first page to the last is as interesting and as appealing to the minds of both young and old alike as the most fascinating novel. The impression made on the reader is as if the authors, when writing their chapters, had put themselves in the position of a friend of the family to whom the young man just out of high school would turn for advice as to what line of studies he should follow. This personal touch goes through the whole book and lends to it an exceptional charm so that even laymen can and will enjoy its reading.

The editorial chapters are delightfully written and in every line reflect the enthusiasm of the editors for the profession, for the personality of the engineer, and for the young people aspiring to become members of the profession.

The chapters dealing with the various divisions of engineering give a concise definition of each branch, describe its good and bad features, the studies necessary for attaining a standing in that line, and the compensation which the aspirant may expect to obtain after going through the various grades of employment.

In the minds of the older readers the book undoubtedly will evoke a great many thoughts. Some of them may not agree with the apparent intention of the writers to raise the plane of education for all engineers to an abnormally high level. Others may say that the necessity of keeping in the best physical condition and the need for mental recreation are not sufficiently stressed. Again there will be some who will criticise the book because certain lines of engineering endeavor, such as city managership, acoustical engineering, patent engineering, etc., have not been covered. These criticisms, of course, if found to be justified by the editors, can be taken care of easily in the later editions.

Miscellaneous Notes on Booklets and Reprints

RAILWAYS OPERATIONS for 1932 are reviewed in a pamphlet, Special Series No. 59, published by the Bureau of Railway Economics, Washington, D. C.

LOSS OF HEAD IN CAST-IRON TEES is the subject of Bulletin No. 41, Texas Engineering Experiment Station, College Station, Texas. Free to a limited distribution.

A SURVEY OF ADULT TECHNICAL EDUCATION in the New York industrial area has been published by the Chamber of Commerce of the State of New York, 65 Liberty St., New York City.

COEFFICIENTS OF FRICTION of bearing metals for bridge seats, appendix D of the 1933 report of the committee on iron and steel structures of the A.R.E.A. has been printed in pamphlet form by the College of Engineering, West Virginia University, Morgantown, W. Va.

CURRENT HYDRAULIC LABORATORY RESEARCH in this country is outlined in Report No. I-1 of the U. S. Bureau of Standards, Washington, D. C. Publication of the report is the result of a request from the American Committee

of the World Power Conference that the Bureau of Standards act as the clearing house for information on current hydraulic research as part of the plan of the World Power Conference to keep all hydraulic laboratories of the world informed as to research in progress.

ECONOMICS OF HIGHWAY IMPROVEMENT is the subject of a pamphlet published by the Portland Cement Association, 33 West Grand Ave., Chicago, Ill. The subject matter was derived from the findings of the committee on the economics of highway improvement of the Highway Research Board. Copies are available on request.

DATA ON TOLL BRIDGES and toll bridge operations are contained in the proceedings of the American Toll Bridge Association, Vol. 1, 1933, reporting the annual meeting held in Camden, N. J., Jan. 16-17. Copies may be obtained from the secretary of the association, 1024 Vermont Ave., Washington, D. C. Price, $1.

INSULATION OF NEW AND OLD HOUSES is the subject of a pamphlet published by the National Development Bureau, Department of the Interior (Dominion of Canada) in cooperation with the Dominion Fuel Board. Copies may be obtained from either the Development Bureau or the Fuel Board at Ottawa, Ont., Canada.

CLAY IN CONCRETE is the subject of Research Paper No. 529, Bureau of Standards, U. S. Department of Commerce. The paper reports the results of a study conducted by the bureau in cooperation with Hugh L. Cooper & Company, New York, N. Y. Copies may be obtained from the Superintendent of Documents, Washington, D. C. Price, 5c.

A GROUP OF CHARTS on community housing displayed at the recent Architectural League exhibition in New York and published with an explanatory statement in the April issue of *Architectural Forum* has been assembled in pamphlet form under the title The Planned Community and may be obtained from *Architectural Forum*, 220 East 42nd St., New York City. Price 25c.

INFORMATION ON STRAY-CURRENT ELECTROLYSIS on file in the U. S. Bureau of Standards has been abstracted and summarized in circular No. 401, entitled "Abstracts and Summaries of the Bureau of Standards, Publications on Stray-Current Electrolysis." Copies may be obtained from the Superintendent of Documents, Washington, D. C., for 5c.

THE UHL RIVER HYDRO-ELECTRIC PROJECT in the Punjab, India, which was put into service on March 10, is described in a pamphlet put out by the hydro-electric branch of the Punjab Public Works Department, Lahore, India. The initial installation in the project is 64,000 hp., but it has been designed and the main supply tunnel has been built for a capacity of 161,000 hp.

WHO PAYS FOR HIGHWAYS? is a question that is answered, in so far as Michigan is concerned, in a pamphlet entitled "Automotive Vehicle Fees and Taxes in Michigan," by John S. Worley, professor of transportation engineering at the University of Michigan. The pamphlet is published by the National Highway Users Conference, National Press Building, Washington, D. C.

AMERICAN CYPRESS AND ITS USES, the third of a series of bulletins on commercial American woods, has been published by the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, as Trade Promotion Series No. 141. The first two pamphlets covered Douglas fir and pitch pine (southern yellow pine). Copies may be obtained from the Superintendent of Documents, Washington, D. C., for 5c.

SUGGESTED PRINCIPLES of state legislation relating to the use of underground water are outlined in Publication No. 3 of the National Land-Use Planning Committee and the National Advisory and Legislative Committee on Land Use, Washington, D. C. W. W. McLaughlin, chief, Division of Irrigation, Bureau of Agricultural Engineering, Department of Agriculture, is chairman of the technical advisory committee.

THE MANY STANDARDS approved by the American Standards Association are listed in the American Standards Year Book, 1932-1933. The scope of each standard is given and the sponsoring organization, also the cost of individual copies of each standard specification. Copies of the year book may be obtained without charge from the American Standards Association, 29 West 39th St., New York, N. Y.

REDUCING THE FLOW OF ARTESIAN WELLS has been under study in North Dakota for twelve years as a result of a legislative act providing for the conservation of artesian water. Methods of reducing flow are described in Artesian Water Paper No. 2 published by the North Dakota Geological Survey, Grand Forks, N. D. "Artesian Waters of North Dakota" is in preparation as Paper No. 6. Groundwaters are covered by Paper No. 5, recently published.

ELECTRIFICATION OF STEAM RAILWAYS, the sixth report of the railway electrification committee of the National Electric Light Association has been published by the liquidating committee of the association, 420 Lexington Ave., New York, N. Y., as Publication No. 247. The price is $1. The pamphlet contains a condensed analysis of installations and the physical characteristics of the electrified sections of steam railways throughout the world. An appendix, occupying about half the pamphlet, gives a detailed description of the Pensylvania Railroad's electrified system.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

CONTRIBUTION A L'ETUDE DES COURANTS LIQUIDES — By Henry Favre. Paper; 7x10 in.; pp. 64; photographs and diagrams. Published by Rascher & Cie., Zurich, Switzerland.

DIE QUELLEN—By Josef Stiny. Paper; 7x10 in.; pp. 252; photographs and line drawings. Published by Julius Springer, Wien, Austria. 17.50 RM.

GENERAL INDEX to the Final Reports of the President's Conference on Home Building and Home Ownership—Prepared under the direction of Dan H. Wheeler. Edited by John M. Gries and James Ford. Cloth; 6x9 in.; pp. 114. Published by The President's Conference on Home Building and Home Ownership, Washington, D. C. $1.15.

THE GOVERNMENT OF THE METROPOLITAN REGION OF CHICAGO—By Charles E. Merriam, Spencer D. Parratt and Albert Lepawsky. Paper; 5x8 in.; pp. 193; maps and tables. Published by The University of Chicago Press, Chicago.

DER GRUNDBAU—By L. Brennecke and Erich Lohmeyer. Paper; 7x10 in.; pp. 160; photographs and diagrams. Published by Wilhelm Ernst & Sohn, Berlin, Germany. 5.70 RM.

THE INDUSTRIAL DISCIPLINE AND THE GOVERNMENTAL ARTS — By Rexford G. Tugwell. Cloth; 6x9 in.; pp. 241. Published by Columbia University Press, New York City. $2.50.

HOW CITIES CAN CUT COSTS — By Clarence E. Ridley and Orin F. Nolting. Paper; 7x10 in.; pp. 58. Published by The International City Managers' Association, Chicago, Ill. $1.

INDUSTRIAL PIPING—Cloth; 5x8 in.; pp. 286; diagrams and tables. Published by Engineering Publications, Inc., 1900 Prairie Ave., Chicago. $3.50.

INFLATION—By Donald B. Woodward and Marc A. Rose. Cloth; 5x8 in.; pp. 153; diagrams. Published by Whittlesey House, McGraw-Hill Book Co., Inc., New York and London. $1.50.

LIGHTHOUSES AND LIGHTSHIPS OF THE UNITED STATES—By George R. Putnam. Cloth; 5x8 in.; pp. 324; photographs and maps. Published by Houghton Mifflin Co., Boston and New York. $3.50.

LIFE INSURANCE HOME OFFICE BUILDINGS—Cloth; 9x11 in.; pp. 155; photographs and tables. Published by Life Office Management Association, Box 1110, Fort Wayne, Ind. $5.

THE NILE BASIN—Vol. II: Measured Discharges of the Nile and Its Tributaries. By H. E. Hurst and P. Phillips. Board; 8x11 in.; pp. 661; tables. Published by Government Press, Cairo. Price 50 P.T.

THE PORTS OF SANDUSKY, HURON, AND LORAIN, OHIO—Lake Series No. 8. Prepared by The Board of Engineers for Rivers and Harbors, War Department, in cooperation with the Bureau of Operations, United States Shipping Board. Paper; 6x9 in.; pp. 156; photographs, maps and tables. Published by Superintendent of Documents, Washington, D. C. 45c.

TRANSITION ZONING—By Arthur C. Comey. Cloth; 7x10 in.; pp. 150; photographs, tables and diagrams. Published by Harvard University Press, Cambridge, Mass. $2.50.

Engineering News-Record

EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, W. G. Bowman, F. W. Herring, C. S. Hill, H. W. Richardson, W. W. De Berard, N. A. Bowers, J. I. Ballard.

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A Notable Anniversary

FIFTY YEARS AGO Brooklyn Bridge was opened to traffic. In the succeeding half century the effulgent prophecies of its inaugurating orators have not only been fulfilled but in large measure surpassed. For today Brooklyn Bridge has the greatest fame of any engineering structure in the New World, a fame compounded of technical originality and excellence, courageous construction, artistic acceptance and long years of meritorious service under exacting and ever-increasing traffic demands. That its semi-centennial should be marked by celebration and retrospect is therefore natural and fitting. Engineers perhaps appreciate more than does the layman the true greatness of the structure and the remarkable ability of the Roeblings, John A., the planner, and his son, Washington A., the builder. They were unaided by our present knowledge of suspension-bridge analysis; the first crude theories that took stiffening-truss action into account did not appear until the bridge was well along toward completion. They courageously embraced steel wire instead of the then more familiar charcoal iron wire. They sunk a compressed-air caisson to unprecedented depths. They developed methods of cable construction that a generation of bridge builders has not seen fit to change except for mechanizing most of the manual operations. Brooklyn Bridge marked an epoch in bridge building. It was still in service when the George Washington Bridge over the Hudson River heralded the next one, a half century later. In the intervening years it became America's best-known and most revered engineering structure. The history of its planning, design and construction and of its long and efficient service is a heritage which engineers should cherish.

Design Integrity

THE EXCELLENT and thorough analysis which C. D. Wailes, Jr., and A. C. Horner have made of the damage done to buildings in Long Beach, Calif., by the recent earthquake brings into bold relief several facts about earthquake-resistant construction. It reveals the effect of good as against poor building laws; it shows the fundamental importance of adequate supervision on the part of administrative officials; and, by implication at least, it stresses the necessity of design honesty and ability. Stated as a paraphrase of a well-known saying, it emphasizes that the three essentials to safe construction are building laws, supervision and honest design—and the greatest of these is honest design. Good building laws are impotent without supervision, and complete supervision is impracticable because of lack of funds and inspectors. Architects and engineers would do well to ponder this fact. Basically, the failure of a building from earthquake, hurricane or any other cause is the fault of the designer or builder. Laws and government can help, but success is up to the individual. The Long Beach analysis shows weak points in the law which can be remedied. It shows that supervision is improving; but it also shows that without individual honesty and a vigilant sense of responsibility on the part of engineers and architects the structures that shelter us will continue to endanger our lives.

The Public Works Recovery Bill

AFTER long and anxious waiting, the Administration's recovery bill, whose principal section provides for $3,300,000,000 of public-works construction, was finally presented to Congress last week. It is a sensational document, one which may truly be said to inaugurate a new era in our national history. In both general content and detail—we speak here only of the public-works section—it is admirable, and its effectiveness seems assured beyond question.

Civil engineers should find special gratification in the fact that the bill embodies in full the principle which they and *Engineering News-Record* have urged upon the government throughout the past year, namely, utilization of employment through public-works construction as the spearhead of attack on depression and deflation. In thus acknowledging the nation's responsibility for re-establishment of worker earning power, the bill discards many bankrupted traditions and sets a new course oriented by the public welfare.

In scope and implications the measure is so vast that present comment can deal only with one or two individual features. But it seems clear that it profoundly affects engineering, construction and public administration, and that for this reason it demands most painstaking study by engineers and public officials particularly. Though it is put forward as an emergency measure only, its influence is likely to extend beyond the present emergency into the practice of normal times.

Certain obstacles that stand in the way of utilizing public construction as a means of business recovery have been widely recognized, and the framers of the bill evidently gave them careful thought. To meet the difficulties arising from taxpayer opposition to public-works expenditures and from the drive for local government economy, the main clause of the bill vests broad authority in the President to plan, finance and construct public works of national or local character. In exercising this authority he may appoint local officials his agents and may contribute up to 30 per cent of the cost of local works. This provision reduces the cost burden of improvement works on the local community both by the national contribution and by the reduction of carrying charges through national financing.

No less important is the second clause, aimed at speed in getting the re-employment program under way. This clause authorizes a greatly enlarged highway schedule—up to a maximum of $400,000,000. As we pointed out last week, highway work is the most rapid means available for initiating employment on a large scale. This was said with only federal-aid roads in mind, but the bill opens still larger opportunities for speed in re-employment by including secondary roads, roads through cities and grade-crossing elimination—a significant extension to new fields of high value for the present

emergency. It is a known fact that a huge volume of grade-crossing improvement work is ready for immediate construction.

A notable detail of the bill provides that in grade-crossing work the state highway departments are to be made federal agencies; it might well add the state utility commissions, since in some states these are in charge of grade-crossing operations. This wise provision strongly furthers the purposes of the bill. It avoids conflicts of authority due to state laws on division of cost, as well as contract complications that might arise were the work done under local authority.

Equally significant is the fact that the bill wipes out the ineffective Title II of last year's Emergency Relief and Construction Act by terminating all authority of the Reconstruction Finance Corporation in connection therewith. But in doing so it maintains opportunity for private construction of public-use facilities—such as toll bridges—to the same degree as the old act, and thus retains such works among the means of re-employment. It maintains also the limitation of working hours for all the works embraced in the re-employment program, and for highway work the requirement that minimum wage rates must be predetermined and specified.

Any consideration, however brief, of this remarkable public-works bill leaves no doubt that it is a recovery measure, and in no sense a charity or relief measure. Doubtless this fact will be recognized by the President's public-works administrator through consistent application of normal construction procedure and efficient methods. Similar recognition by local officials and authorities will further contribute to the success of the program. The most important aid, however, that local authorities can give toward rapid recovery is to take time by the forelock in developing their pending and deferred projects while the bill is yet before Congress, and so far as possible complete their engineering plans ready for contract by the time the President's administrator takes office.

Industry Control for Stabilization

THAT SECTION of the recovery bill which provides for industrial reorganization through industry control presages even more profound change in economic and social method than the public-works section, and is perhaps of more enduring importance. Its direct purpose may be said to be control of unbridled competition, but clearly it is much more than this, for in effect it creates a virtual partnership between government and industry, in the interest not only of industry itself but also of worker and public. It neutralizes the anti-trust laws without repealing them.

Problems of great magnitude are placed before industry by the bill, especially before the construction industry, which is more subdivided and less effectively organized than others. Under the strain of over-expansion and collapse the producing industries that serve construction have experienced a thorough disintegration of commercial policy. Now they are called to reorganize for sound and stable operations consistent with the interests of worker and public.

Adjusting industry to the new system of control is relatively simple in the case of large and well-differentiated industrial groups. Most of these already are well organized and have little difficulty from overlap with other fields or from conflict of local interests. Few of the construction industries present such favoring conditions. The materials industries are much split up, those of machinery and equipment even more so, and many conflicting conditions occur. Brick manufacture is strongly affected by local factors with respect to character of product, commercial methods and labor relations. Lumber involves competition between southern and west-coast material. Equipment production is segregated in small groups to a degree that makes effective central control highly difficult. To adapt these conditions to the kind of public-interest control contemplated by the bill calls for wise, broad-gage planning. It will be well if this is undertaken without delay.

Fortunately, the leading groups of these industries have already begun active planning and discussion of organization. Two distinct objectives are emerging in this process: control of production and commercial policies on the one hand, determination of labor relations on the other. The former may prove to be most effectively handled in small-unit groups, the other in larger integrated groups. These are objectives of such surpassing importance with respect to sound future development as to warrant the most serious and considered effort to harmonize divergent views and reshape industrial organization for that broad cooperation which the industry control bill seeks to bring out.

The Tennessee Valley Plan

THE SO-CALLED Muscle Shoals bill has become law, and the President already has named the chairman of the board of three men who, as the Tennessee Valley Authority, will be charged with the responsibility for carrying out the provisions of the act. The provisions that are of immediate interest to the readers of this journal provide for (1) construction of the Cove Creek Dam by the Secretary of War or the Secretary of the Interior, who may do the work "directly or by contract," and (2) installation of additional turbines and electric generators in both the steam and hydro-electric plants at Muscle Shoals. The second is to be done by the Tennessee Valley Authority. A quick start on the Cove Creek plant may be expected, as it is to be built by one of two existing agencies. Preliminary plans already have been prepared by the Corps of Engineers, and the Corps now has parties in the field making property surveys. With the powers of condemnation and eminent domain available, there is no reason why Cove Creek should not be under way by early summer.

To those who are familiar with his past achievements the appointment of Arthur E. Morgan as head of the Tennessee Valley Authority constitutes solid assurance that the undertaking will be guided soundly to a useful and constructive result. Morgan's breadth of view, originality and forcefulness made possible the solution of the apparently unsolvable Miami River flood problem, and the Ohio Conservancy Law which he shaped served as precedent for the legislation under which other flood-protection enterprises of large magnitude were worked out. All these were regional matters, in which consideration of the best interests of an entire countryside had to guide the planning. The Tennessee Valley will present larger problems, perhaps, but of closely similar kind. With his past flood-protection and reclamation background, and with the help of the human and social thinking that his work at Antioch College called forth, Mr. Morgan will bring to the Tennessee Basin all the qualities that can contribute to its fullest development.

NEWS OF THE WEEK

Tennessee Power To Be Supplemented Under New Law

CONSTRUCTION of Cove Creek dam and the installation of more steam and hydraulic turbines in the Muscle Shoals plants is provided for in the Tennessee Valley development bill signed by President Roosevelt on May 18. The largest single element of construction definitely provided for in the act is the combined storage and power dam at Cove Creek on the Clinch River, one of the principal tributaries of the Tennessee. The cost of this project, exclusive of navigation facilities, was estimated by the army engineers in 1929 to be $33,990,000.

The act creates the Tennessee Valley Authority consisting of three members appointed by the President by and with the advice and consent of the Senate, one member to be replaced each three years. To be eligible for membership on this board a candidate must profess a belief in the feasibility and wisdom of the act, and must have no interests financial or otherwise in any public utility selling power or in any corporation engaged in the manufacture or sale of nitrogen or fertilizer.

The act authorizes the President to turn over to the Tennessee Valley Authority all government property at Muscle Shoals except the locks, vests the Authority with the power of eminent domain, authorizes it to produce fertilizer or to contract with commercial producers for the production of fertilizer at Muscle Shoals, authorizes it to carrry on experiments with the view of reducing the cost of fertilizer and permits it to provide farm organizations with fertilizer for large scale experimental purposes.

Power Development

The Tennessee Valley Authority is authorized to produce, distribute and sell electric power and the act declares that it is the policy of the government so far as practical to distribute the surplus power generated at Muscle Shoals equitably among the states, counties and municipalities within transmission distance of the plant. For this purpose, the board is authorized to lease or construct transmission lines and to contract with states, counties, municipal organizations or private corporations for the sale of electricity for a period not exceeding 20 years. Sales of power to public bodies who construct their own transmission lines shall be for a period not exceeding 30 years. The board maintains control over the resale price of current sold by it.

Five per cent of the gross income from the sale of power generated at plants in Tennessee is to be paid to Tennessee and five per cent of that received from plants in Alabama to the state of Alabama. Two and one-half per cent of the gross income from power resulting from the use of water stored in the Cove Creek reservoir or other storage reservoirs is to be paid to each state.

The board is instructed to determine what part of the cost of Dam No. 2 at Muscle Shoals and what part of the Cove Creek dam is chargable to flood control, navigation, fertilizer, national defense, and the development of power, and when approved by the President these figures shall be used in the cost accounting of the board.

New Construction

The act authorizes the board to complete the power plants at Muscle Shoals by the installation of additional hydraulic turbines and generators in the hydro-electric plant and steam-electric generators in the steam plant. Further, it authorizes either the Secretary of War or the Secretary of the Interior to construct (directly or by contract) the Cove Creek dam, including the power house with an installed capacity of 200,000 hp. The President is authorized to place control of the construction of this dam in the hands of engineers taken from private life. The power of eminent domain and to condemn land is vested in the Secretary in charge of this work. Payment of prevailing wages is required but the 30-hr. week limitation is not set up.

The act authorizes the President to make such surveys of and general plans for the development of the Tennessee basin and the adjoining territory as may be useful to Congress, and to recommend to Congress, from time to time, such legislation as he deems proper to carry out its general pur-

(Continued on p. 698)

Many Rivers Reported in Flood in Central and Southern States

Reports from many points in the Central and Southern States indicate serious floods in tributaries of the Mississippi River. Both the Ohio and the Mississippi rivers are swollen by the flood waters but no serious damage is reported except along the tributaries. The Wabash and lower White River are over their banks and causing considerable damage in Ohio, Kentucky, Indiana, and Illinois: serious breaks have occurred in the levees on the Arkansas side of the St. Francis River and floods are reported from wide areas in Oklahoma.

In the Miami River valley in Ohio, 5½ inches of rain fell in the period from May 8 to 13, and as a result more water was held back in the Englewood and Taylorsville retarding basin than at any time since the reservoirs were completed in 1922. The maximum storage in the Englewood basin amounted to 55,000 acre-ft., or about 18 per cent of the storage capacity. About 13,000 acre-ft. was accumulated in the Taylorsville reservoir, or about 7.2 per cent of the capacity.

At Dayton, the maximum river stage was 14.1 ft., representing a discharge of 50,200 sec.-ft. This stage has been exceeded only once since the completion of the flood control work.

U. S. Court Orders Illinois to Finance Chicago Sanitation

THE STATE of Illinois has been ordered by the U. S. Supreme Court to provide the money needed by the Chicago Sanitary District to complete its sewage disposal system by Dec. 31, 1938, the date set by the court in its decree issued on April 21, 1930, requiring the city to reduce its diversion of water from Lake Michigan through the Chicago Drainage Canal to 1,500 sec.-ft. The court's new decree is the outcome of a complaint entered last fall by the states of Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin to the effect that the court's earlier decree was not being complied with. The Chicago Sanitary District replied (*ENR* Nov. 17, 1932, p. 602) that it had begun its program of sewage disposal plant construction in good faith but that it had been unable to finance its continuation under present conditions.

The Supreme Court in its findings states that responsibility for the continuation of the work rests with the state of Illinois as the sanitary district was created by the state.

The court said that "despite economic conditions the state has adequate resources, and we find it impossible to conclude that the state cannot devise appropriate and adequate financial measures to enable it to afford suitable protection to its people to the end that its obligation to its sister States, as adjudged by this court, shall be properly discharged."

The original decree has been amended to require that the State of Illinois take all necessary steps to carry out the court order, including whatever appropriations may be needed. Further, the state has been ordered to report to the court by Oct. 2, 1933 that the decree is being complied with.

Large Mexican Highway Contract Will Total Nearly $13,000,000

Contracts for the completion of certain trunk highways and the construction of others in Mexico, recently unofficially reported in these pages as having been let to Camilo Figueroa, Mexican engineer and highway builder, have been officially announced by Leopoldo Frias, director of the highway department of the Ministry of Communications and Public Works. The amount of work involved, however, totals 40,000,000 pesos (about $13,000,000) instead of 31,000,000 pesos as first reported.

The work includes completion of the highway between Mexico City and Nuevo Laredo on the international border and other main routes in Mexico. The contract calls for the completion by the end of 1936. Payments will start to the contractor in 1934 and will be completed by 1939.

New Bids Received for Cement for Construction of Hoover Dam

New bids opened by the U. S. Bureau of Reclamation on May 17 for 400,000 bbl. cement for Hoover Dam are unofficially reported to show little change in prices from those submitted a month ago, which were rejected by the Secretary of the Interior. Proposals were asked for on three items: (1) special low-heat cement of the same specifications as called for in former proposal; (2) modified specifications for special low-heat cement (*ENR* May 18, p. 666) (3) standard portland cement. The rejected bids for the special low-heat cement were $1.55 per bbl., submitted by a combination of four companies, and $1.39 per bbl., submitted by the Union Portland Cement Co. for 50,000 bbl. f.o.b. Devils Slide, Utah. Three proposals were received on the new schedules. The California Portland Cement Co., Riverside Cement Co., Monolith Portland Cement Co. and Southwestern Portland Cement Co. bid jointly as follows: Item 1—$1.55; Item 2—$1.42; Item 3—$1.30. The Calaveras Portland Cement Co. bid: Items 1 and 2—$1.65; Item 3—$1.60. The third bid was submitted by the Union Portland Cement Co.: Items 1 and 2—$1.34; Item 3—$1.25. All bids were for cement in bulk, f.o.b. mills. The last cement bought for Hoover Dam was purchased last September, the four firms above getting a combined contract for 332,000 bbl. of standard portland cement at $1.24. The Union Portland Cement Co. also obtained a contract for 67,500 bbl. at $1.04.

Large Extras Claimed on Tunnel for Baltimore Water Supply

A claim for $477,901 has been filed with the Public Improvement Commission of Baltimore by the Whiting-Turner Construction Co. of Baltimore for extra work performed in the construction of the Montebello-Druid Lake water tunnel, which was placed in service recently. The tunnel was a municipal undertaking costing $1,145,000. The claim is based upon the extra cost involved through unforeseen conditions that the contractor maintains developed on the work and from disagreement as to the classification of material encountered.

Abitibi Canyon Power Project To Be Completed by Commission

The Hydro Electric Power Commission of Ontario has decided to proceed immediately with the completion of the Abitibi Canyon hydro-electric enterprise on the lower Abitibi River in northern Ontario. Work was actively carried forward on this big project by the Ontario Power Service Corporation, Limited, until July of last year. Financial difficulties, however, caused cessation of operations at that time. In the meantime, the Hydro Electric Power Commission purchased the property under judicial sale when a tender of $14,000,000 was accepted by the court. The commission will now carry the work to completion making available immediately 100,000 hp. of electric energy for distribution over the commission's transmission lines built to supply the International Nickel Co. at Sudbury and other northern Ontario customers.

Arthur E. Morgan Named Head of Tennessee Valley Authority

Arthur E. Morgan, president of the Dayton Morgan Engineering Co., and also president of Antioch College, Dayton, Ohio, was appointed by President Roosevelt on May 19 to be head of the board of three men who will constitute the Tennessee Valley Authority under the legislation recently passed by Congress.

Mr. Morgan is one of the country's foremost authorities on river control and land drainage. As supervising engineer for the U. S. drainage investigation from 1907 to 1909 and as chief engineer of the Miami Conservancy District, a district that did notable pioneer work in flood control, Mr. Morgan had an unusual opportunity to study what will be one of the major

Arthur E. Morgan

problems of the Tennessee Valley Authority. Further, in his private practice, first as head of the Morgan Engineering Co. from 1909 to 1920 and more recently as president of the Dayton Morgan Engineering Co., both specializing in flood control and land reclamation work, he has obtained wide experience in those fields. He has drafted or aided in the drafting of the drainage codes of Minnesota, Arkansas, Mississippi, Ohio, Colorado and New Mexico.

Born in Cincinnati, Ohio, in 1878, Mr. Morgan began his engineering studies at the Colorado State University but was compelled to give up the close college work on account of his eyesight. After a few years at farming and other outside work, he joined his father in engineering work in Minnesota and there laid the foundation for his subsequent career.

Michigan Highway Work Stopped Pending New Legislation

Highway construction and improvement work in Michigan being carried out with R.F.C. relief funds, has been ordered discontinued by Highway Commissioner Grover C. Dillman, pending the outcome of state legislation proposing to divert highway revenues to welfare purposes. About 29,000 men are out of work as a result. The work relief program will be resumed as soon as the state legislature passes legislation to meet the R.F.C. requirements.

Federal Agencies Ordered to Compile Public Works Program

SO THAT the $3,300,000,000 public works program may get under way promptly, the construction agencies of the federal government such as the Supervising Architect's Office, the Army Engineer Corps, the Navy Bureau of Yards & Docks, the Reclamation Service and a score of others have been instructed to submit project schedules by May 25. Of less importance than the total that this canvass of projected federal public works may reach are the priorities that will influence selection. Projects will be preferred that do not entail much subsequent expense for maintenance and operation.

The guide that the federal construction agencies will follow in recommending projected work for inclusion in this program is as follows:

Types of work that do not entail annual federal expense for either physical upkeep or operating personnel and facilities, or both.

Reconditioning of existing structures, vessels and other facilities.

Projects close to unemployment centers.

Projects that are designed and contracts can be awarded at an early date, that can be organized to give early employment to the maximum number of men, where sites are available or can be quickly acquired and those that rapidly call for material and equipment produced in unemployment centers.

Projects that may be wholly or partially manned by unemployed other than normal construction workmen.

Projects which present government policies contemplate within a 6-year period.

Projects of a revenue producing character.

Projects of moderate size, that are not dependent upon seasonal conditions, and those that do not employ wards of the government.

Replacement of necessary facilities now obsolete.

Bids Taken Soon on Tunnel for Mono Basin Water Supply

Plans for the 12.3-mile tunnel of the Mono Basin water supply system of the Department of Water of the City of Los Angeles are expected to be ready for the call for bids within the next two months. The Mono Basin is on the east side of the Sierra Nevada range and north of Owens Valley, the present major source of the city's water supply.

The tunnel is to be a horseshoe section, 9 ft. wide inside the concrete lining. It is to be constructed from six headings, including two from deep shafts. Construction roads have been built to the tunnel portals.

Some time ago the city voted a bond issue of $8,000,000 for the Mono Basin project and since that time has been negotiating with property owners for water rights and land, also for power supply for construction purposes. H. A. Van Norman is chief engineer of the city water department.

Tennessee Power To Be Supplemented

(Continued from p. 696)

poses, namely, (1) The maximum amount of flood control; (2) the maximum development of the Tennessee River for navigation purposes; (3) the maximum generation of electric power consistent with flood control and navigation; (4) the proper use of marginal land; (5) the proper method of reforestation of all lands in the drainage basin suitable for reforestation; and (6) the economic and social wellbeing of the people living in the river basin.

Corps of Engineers Report

In 1929 the Corps of Engineers completed a detailed study of the power, flood control and navigation development of the Tennessee Valley. A summary of that report was published in our issue of May 11, page 579. At the time that summary was prepared, legislation before Congress included provision for the construction of Dam No. 3 on the main river above the dam at Muscle Shoals. That work is not specifically provided for in the act just passed.

The act empowers the board to "issue on the credit of the United States and to sell serial bonds not exceeding $50,000,000 in amount" having a maturity not exceeding 50 years and an interest rate not exceeding 3½ per cent. All appropriations necessary to the carrying out of the act are authorized.

Cove Creek Dam

A review of the Army Engineer's report in the light of present conditions indicates that the unit costs used therein may have to be revised downward considerably, and it is understood that the design of the dam will be changed to some extent in the light of developments since the report was prepared.

Investigation of the site of the Cove Creek Dam made by the Corps of Engineers indicates that no serious construction difficulties are likely to be encountered. Located in a sharply-rolling sparsely-settled farming area, the site is about six miles from a single-track line of the Southern Railway. A branch line to reach the site, located in a river bottom where the grading is light and with one crossing of the Clinch River, would cost $750,000, according to the army engineers' estimate. As the project will require rail connections, this line doubtless will be built for permanent use.

No good highways reach the dam site. The project, however, contemplates a highway across the dam and as a considerable relocation of highways above the dam will be required, it may be that paved road will be extended to the site by the state in the rearrangement.

Dolomitic limestone underlies the dam site with comparatively little overburden. Some seams and small cavities occur near the surface of this rock formation. Extensive diamond core drilling at the site, coupled with hydraulic-pressure tests, indicate that considerable grouting may be necessary to make the foundation tight under the head brought on the formation by the 230-ft. stage when the reservoir is filled.

Camp sites

Suitable locations for the construction plant and camps are few. Downstream from the dam site it would be practical to fill an area to above flood stages in the river by using the overburden and rock that will have to be removed. This made land would be crossed by the branch built up the river from the main rail line.

Electric power may be obtained from the transmission line of a large public utility that passes within a quarter of a mile of the dam site. Coal is mined not far from the project.

No suitable sand for concrete occurs in the immediate vicinity but tests of the dolomitic limestone indicate it could be crushed to produce a sand satisfactory for that purpose. Large deposits of excellent sand and gravel occur in the French Broad River near Knoxville, Tenn., about 30 miles from the site. These deposits are worked extensively by operators who have ample plant installed to meet the needs of this project.

Climatic conditions would permit construction operations throughout the year. Such excavation as would be required could be done at all seasons, but will probably be finished before the next winter starts.

Available labor

Ample local white common labor is available. Much of this could be obtained from nearby farms and hamlets within easy driving distance, thus reducing the camp facilities needed. Local wage scales are always much below those in the industrial sections of the country. Some classes of skilled labor may be recruited locally, but a few would have to be imported. Open-shop policies obtain in the nearby industries.

Unit prices used in the original estimates were prepared prior to the depression. For example, 59,950 cu.yd. of earth excavation for the main dam was figured at $1.00 per yd. Some 75,000 yd. of rock removal at the dam site was based on $4.00 per yd. State highway contracts were taken in this vicinity in 1932 at less than one-third of these figures. No contracts of any size have been let nearby lately, but local prices are still low.

According to the engineers' estimates mass concrete in the main dam was expected to cost $10 per cu.yd. for the 604,000 yd. involved. Local contractors believe this unit price can be much reduced now, after allowing for increases in prices of materials that may come and also for higher wages that may have to be paid before the job is done.

Sufficient information is available to permit contracts to be let immediately for the rail connection, the excavation for the main dam and power house, and for clearing the reservoir site. Final designs for the dam and power house could be finished so contracts for them might be let in time to permit work to start as soon as the foundations were ready.

Maj. Gen. Lytle Brown, Chief of Engineers, U. S. Army, has had general supervision of the project, with Major R. R. Neyland in direct charge as district engineer.

Clinch River valley at Cove Creek in Tennessee showing the approximate location of proposed storage and power dam.

Construction Stopped on Lock at Dam No. 3 on the Tennessee

The President has ordered work stopped on construction of the navigation lock at the site of Dam No. 3 (Gen. Joe Wheeler Dam) on the Tennesse River pending organization of the Tennessee Valley Authority, according to press reports from Washington on Monday.

These reports of this action published widely throughout the country state that it was taken following a report of Louis Glavis, chief of the Interior Department's navigation bureau, to the effect that the *dam* at that site was being built without authorization, that it was in conflict with the development work now proposed, and that contract for it had been let secretly by the Corps of Engineers.

Public records do not support this statement as reported. Construction of dam No. 3 and its navigation lock was approved long ago as part of the program for improving navigation in the Tennessee River but money has not been appropriated for it in the regular appropriations. Drawings of it were reproduced in our issue of May 11, p. 582 in an abstract of the Corps of Engineers report on development of the river. Last year, under the Relief Act, $1,500,000 was allocated to the Tennessee River and bids were called publicly for the construc-

tion of the lock at Dam No. 3 (there being insufficient money for the dam and lock) and the contract was awarded in December. Notices of the call for bids and award of contract were published in *Engineering News-Record* Oct. 27 and Dec. 7.

Progress in Engineer Relief at New York and Philadelphia

Recently two reports upon emergency relief work for engineers have been made public, one the first annual report of the Philadelphia Technical Service Committee and the other a report of Frederic R. Harris, general chairman of the Professional Engineers Committee on Unemployment, New York, from Oct. 1, 1932, until April 1, 1933, when he resigned to become a member of the Emergency Work and Relief Administration of the City of New York.

The Philadelphia Technical Service Council represents twelve engineering organizations there. Of the 1,611 men registered with the committee, 321 were placed with 221 firms in Philadelphia, and over 1,250 were referred to various positions. In addition, 179 were placed in regular salaried jobs, and 90 men were employed on "useful work," making studies for such organizations as the Franklin Institute, assisting in the Philadelphia renovize campaign, and doing non-competitive work for some of the city bureaus of Philadelphia.

In support of the work $43,700 had been pledged up to April 1, and $38,364 received. Of this amount, $23,842 was spent on the "useful work" operations. This is exclusive of a little over $3,000 paid for similar work in August and September, 1932, but not included in the accounting under that heading.

New York Work

In the six months covered by Admiral Harris' report, 2,468 unemployed engineers registered with the Professional Engineers Committee on Unemployment, and of these 80 were carried on the P.E.C.U. payroll, 510 were placed through the emergency work bureau and other general public committees, and 227 were placed in permanent jobs. A total of $40,031 had been contributed up to April 1, and with the $20,242 received from the committee in charge last year the committee had $60,274 available for use. Unpaid pledges amounted to $5,562. Donations of clothing were estimated at about $2,800, and cash for administration purposes amounted to $3,028.

Loans totalling $4,991 have been made by the committee and eight, amounting to $390, have been repaid already.

Waterworks Convention Special

For the accommodation of members of the American Water Works Association from the eastern part of the country going to the association convention in Chicago, arrangements have been made for a special train leaving Pennsylvania Station, New York, at 6:15 p.m. Eastern Standard Time on Saturday, June 10. The train will leave Philadelphia at 8:03 p.m., and Harrisburg at 10.28 p.m., arriving in Chicago at 1:45 p.m. Sunday.

SOCIETY CALENDAR

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Chicago, June 27-30.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Chicago, June 26-30.

AMERICAN WATERWORKS ASSOCIATION, annual meeting, Chicago, June 12-16.

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS, annual convention, Chicago, June 26-28, 1933.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, annual meeting, Chicago, June 27-30.

ENGINEERS WEEK, Century of Progress Exposition, Chicago, June 25-30.

NEW YORK STATE SEWAGE WORKS ASSOCIATION will hold its spring meeting at Rochester, N. Y., June 9-10.

NEW ENGLAND WATER WORKS ASSOCIATION and the **BOSTON SOCIETY OF CIVIL ENGINEERS** will hold a joint outing at the Presidential Club (formerly the Sandy Burr Country Club) at Wayland, Mass., on June 20.

MUNICIPAL FINANCE OFFICERS' ASSOCIATION will hold a conference to discuss debts, relief, economy, taxation, accounting and organization at the Hotel Gibson, Cincinnati, Ohio, June 13-15. All public officials are invited.

NEW YORK STATE SOCIETY OF PROFESSIONAL ENGINEERS, at its annual meeting held in New York on May 20, elected Arnold G. Chapman president to succeed David B. Steinman. Vice-presidents elected were Frederick R. Harris and Dwight B. LaDu. Ernest F. Fox was elected financial secretary and P. M. Corry treasurer.

PACIFIC NORTHWEST SECTION, American Water Works Association, at its convention held at Bellingham, Wash., May 12-15, elected G. B. Shunke, Seattle, chairman; W. P. Hughes, Lewiston, Idaho, vice-chairman; and E. C. Willard, Portland, Ore., secretary-treasurer.

LOUISIANA SECTION, American Society of Civil Engineers, at its recent annual meeting, elected John Riess president to succeed George P. Rice. John H. O'Neill and F. P. Hamilton were elected vice-presidents and H. A. Sawyer secretary, and Richard L. Moroney treasurer.

METROPOLITAN SECTION, American Society of Civil Engineers, at its annual meeting held in New York on May 17 elected Thaddeus Merriman president, to succeed Malcolm Pirnie. David B. Steinman was elected vice president and Jacob S. Langthorn treasurer. Directors elected were Arthur G. Hayden, William W. Brush and E. M. Van Norden.

THE HYDRAULIC DIVISION of the American Society of Mechanical Engineers and the Power Division of the American Society of Civil Engineers will hold a symposium on waterhammer in Chicago on Friday, June 30. Both societies will conclude their summer meetings on that date. The papers to be presented at the session are being printed privately under the auspices of the A.S.M.E. Copies may be obtained from the society's headquarters at 29 West 39th St., New York, about June 1; $1 to members, and $1.50 to non-members.

Use of Conservation Corps Men on River Work Considered

At the request of the Chief of Engineers, U. S. Army, engineers of the Memphis district have prepared plans for the employment of 80,000 members of the Civilian Conservation Corps on flood control work on the Mississippi River. The men would be used largely for clearing floodways of brush and undergrowth, clearing levees and building roads along the levees.

No definite decision has yet been made as to the use of these men on the Mississippi River work, the study was made to determine how many could be usefully employed.

Obituary

GEORGE F. DAVIS, former engineer on railroad construction in the West, died at his home in Denver May 11, age 70 years.

HENRY P. BURGARD, founder of the contracting firm of Henry P. Burgard Co., and one of the principal contractors on the New York State barge canal, died at his home in Buffalo, N. Y., May 17, age 72 years.

DWIGHT R. REDMAN, engineer of the U. S. Indian Service at Coolidge, Ariz., on the San Carlos irrigation project, died there on May 15 of a self-inflicted wound. Previous to his going to Coolidge, Ariz., Mr. Redman was an engineer on the Wapato irrigation project in Washington.

JOSEPH T. RICHARDS, formerly chief engineer maintenance of w.. of the Pennsylvania R.R., died at his home in Cape May, N. J. on May 17, age 88 years. Mr. Richards had retired from active service in 1915. He began his engineering career as a rodman on the Pennsylvania.

ARVID RYDSTROM, contractor and former commissioner of public works at Tacoma, Wash., died at his home there on May 12, age 76 years. Mr. Rydstrom was a native of Sweden and came to the United States in 1881. From 1887 to 1892 he was in charge of construction of the Northern Pacific Terminal at Tacoma and from 1892 to 1897 served as commissioner of public works.

ROBERT H. SIMPSON, chief engineer of the department of public service, Columbus, Ohio, died there on May 18 of influenza followed by heart failure. Mr. Simpson was 60 years old and had been in ill health for some time. He was a graduate of the civil engineering course at Cornell University in the class of 1896 and from the time of his graduation until 1904 he was with the Cleveland, Cincinnati, Chicago & St. Louis Railroad in its engineering and construction department. In 1904 he entered the service of the city of Columbus and from 1906 to 1920 was engineer in charge of grade crossing elimination projects and of the Scioto River channel improvement work. In 1920 he was appointed chief engineer of the department of public service.

Brief News

THE USE OF SCRIP for the payment of employees of the contractor on Boulder Dam has been ordered discontinued by the Secretary of the Interior.

A TUNNEL THREE MILES LONG on the Transandean railroad line connecting the railroad system of Argentine with that of Chile was holed through on May 16. The operation was made the subject for a celebration, the President of Chile setting off the blast by pressing a button in the presidential palace at Santiago.

A FIRST-ORDER TRIANGULATION SURVEY has been begun in the vicinity of New Brunswick, N. J., and will extend from there to Trenton and then southward along the Delaware River. The U. S. Coast and Geodetic Survey office at New York has announced that engineers interested in

visiting the work should communicate with Lieut. H. C. Warwick, U. S. Coast & Geodetic Survey, Trenton, N. J.

RECONSTRUCTION OF THE JETTIES at the mouth of the Panuco River which form the harbor at the port of Tampico, Mexico, has been approved by the Mexican government and bids for contracts are to be called soon. The project is estimated to cost about $1,200,000. The partial destruction of the present jetties has caused a silting of the channel.

THREE METHODS FOR ENDING POLLUTION in the Potomac River have been laid before the commissioners of the District of Columbia by Major John C. Gotwals, engineer commissioner. Two have to do with temporary expedients and the third calls for further consideration of a comprehensive scheme for sewage disposal, estimated to cost between $8,000,000 and $9,000,000.

CONSTRUCTION OF A SEAWALL at a cost of about $850,000 at Jacksonville Beach, Fla., is provided for in a bill now before the state legislature. Under the bill, 25 per cent of the gas tax revenue allotted to Duval County would be diverted to a sinking fund to retire certificates of indebtedness and the balance of the cost up to 50 per cent would be levied against abutting property.

CONSTRUCTION OF A HIGH-LEVEL BRIDGE across the Clyde River at Finnieston, Scotland, is proposed by the Corporation of Glasgow. It is reported that the corporation soon will call for bids on the construction of the bridge, estimated to cost $6 100,000.

SUITS FOR DAMAGES TOTALING $823,000 have been filed against the city of Columbus, Ohio, by property owners south of the city along the Scioto River because of pollution in the river. The city has been ordered to cease polluting the river, but has not yet undertaken the construction of its proposed new sewage disposal plant. Recently 14 suits with damages totaling $195,000 were settled by compromise with the plaintiff.

CONSTRUCTION OF A DAM at Eastevan, Saskatchewan, to control the waters of the Souris River, is again reported to be under consideration by officials of the provincial government and representatives of the United States government. The latter is involved because of the fact that raising the level of the river would flood land in the city of Minot, North Dakota. An earth dam costing between two and three hundred thousand dollars is being considered.

AN INTERSTATE PORT AUTHORITY for the development of the Illinois-Indiana shore line above Lake Michigan is called for under a resolution recently adopted by the Illinois State Legislature. The Indiana General Assembly adopted a similar resolution at its 1933 session and appropriated $50,000 for the project. This was done upon the recommendation of a survey commission created at the 1931 session. The Illinois resolution authorizes Governor Horner to cooperate with Indiana in setting up a joint state body.

Engineering Contracts and Capital

HEAVY engineering construction contracts reported for the past week total $7,800,000, the third consecutive week of low volume. Because of the $54,000,000 total reported the first week of the month, the average weekly awards for May amount to $19,549,000. Last year May contracts averaged $26,936,000 per week. This year's May average is 50 per cent greater than the April average of $12,348,000. Last week private contracts exceeded public works awards, a rare occurrence in these times. Private awards amounted to $4,100,000, half of which was for industrial buildings, and public lettings were only $3,700,000. Federal awards were $771,000, a gain over the previous week, but still far below the average federal contract figure. Highway lettings are unusually low for this time of year, amounting to only $1,300,000. Cumulative contracts to date continue to fall behind last year's corresponding figures, amounting this year to $341,430,000, as compared with $479,528,000 for the same period of 1932.

The list of proposed large projects announced last week is heavier than for some time. Included in it are passenger station, Houston, Tex., $1,200,000; Railroad Ave. improvements, Seattle, $1,200,000, bids asked June 8; county court house, Kansas City, $2,500,000, bids asked June 9; automobile track and sports development, Secaucus, N. J., $7,500,000; and two new bridges over the Delaware between Pennsylvania and New Jersey, $1,000,000 each.

New productive capital issues sold during the week total $991,000, including $325,000 advanced by the R.F.C. on previously committed self-liquidating loans. Cumulative new capital to date this year is far behind last year's total. To date this year capital issues total $114,368,000, as compared with a total of $349,000,000 for the same period last year.

Contracts and Capital

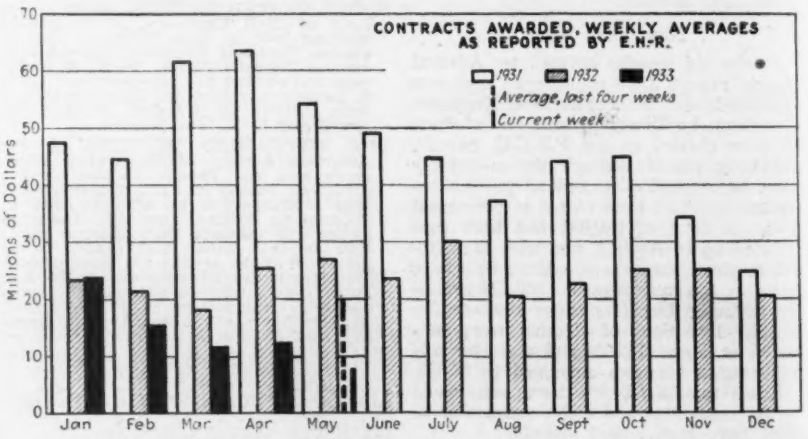
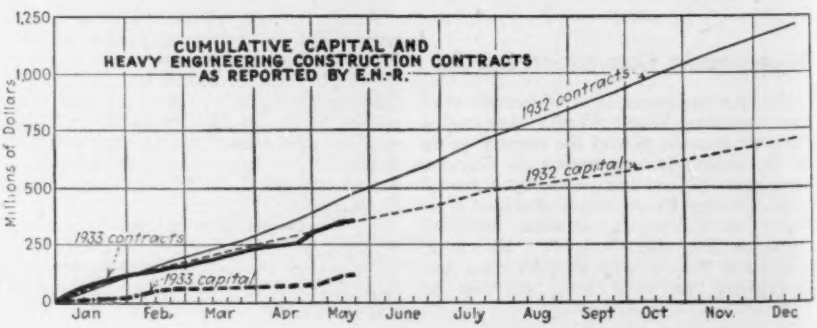
CONSTRUCTION
(Thousands of Dollars)

	Weekly May, 1932	Average Four Weeks	Week May 25 1933
Federal government	$6,530	$751	$771
State and municipal	13,160	14,360	2,929
Total public	$19,510	$15,111	$3,700
Total private	7,426	4,438	4,100
Week's total	$26,936	$19,549	$7,800
Cumulative to date:			
1932		$479,528	
1933		341,430	

NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

	Weekly May, 1932	Average Four Weeks	Week May 20 1933
New capital issues	$18,000	$10,595	$991
Cumulative to date:			
1932		$349,000	
1933		114,368	

R.F.C. self-liquidating loans:	
Approved current week	$985,000
Approved to date (including 1932)	205,667
Actual loans made (including 1932)	46,943

ENR Cost and Volume Index

E.N.-R. Cost		E.N.-R. Volume	
May, 1933	164.39	April, 1933	65
April, 1933	160.16	March, 1933	62
May, 1932	152.78	April, 1932	135
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260
1913 Average	100